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PULMONARY PNEUMATOCELE (LOCALIZED ALVEOLAR OR LOBULAR ECTASIA)¹

CERTAIN CONSIDERATIONS IN CYSTIC DISEASE OF THE LUNG

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THE common lack of information in regard to the antecedent respiratory history of patients with cystic pulmonary disease raises grave doubt of the propriety of the term "congenital" in a roentgenologic diagnosis of cystic disease.

Recent essayists have included a wide variety of pulmonary changes under the classification of "congenital cystic disease," the common feature being round air spaces of varying size and number. Many have accepted the theory of a congenital abnormality as the basic lesion with apparently little doubt. Actual fluid-filled cysts are rare in the reported cases.

Dr. Carl V. Weller, Director of the Pathology Laboratories of the University of Michigan, has recently stated to the authors, "I can recall no instance in which we have found changes in the lungs of newborn infants or very young children which have led us to make the diagnosis of congenital cystic disease of the lung. Judging by analogy with other organs derived from the primitive alimentary tract, one would expect that a condition properly thus design-

nated would be encountered occasionally."

Subsequent to birth and the origin of respiratory life, any change in the lungs must be critically analyzed in the light of the age of the patient, the degree of initial post-natal inflation of the lungs, the time relationship of the first examination during which roentgenograms give evidence of the existing structural state of the lungs, antecedent minor or major respiratory infections, or intercurrent disease which may have masked a pulmonary disturbance.

Although it may seem more simple to consider a congenital abnormality the foundation of all the changes which have been included recently under the title of "congenital cystic disease," we find it difficult to accept such a relationship of cause and effect.

It is our opinion that the roentgen diagnosis of cystic pulmonary disease should be more properly classified under the following four main titles, only one of which is known to be of congenital origin:

- I True congenital pulmonary cyst or cysts;
- II (a) Chronic interstitial pneumonitis with emphysema;

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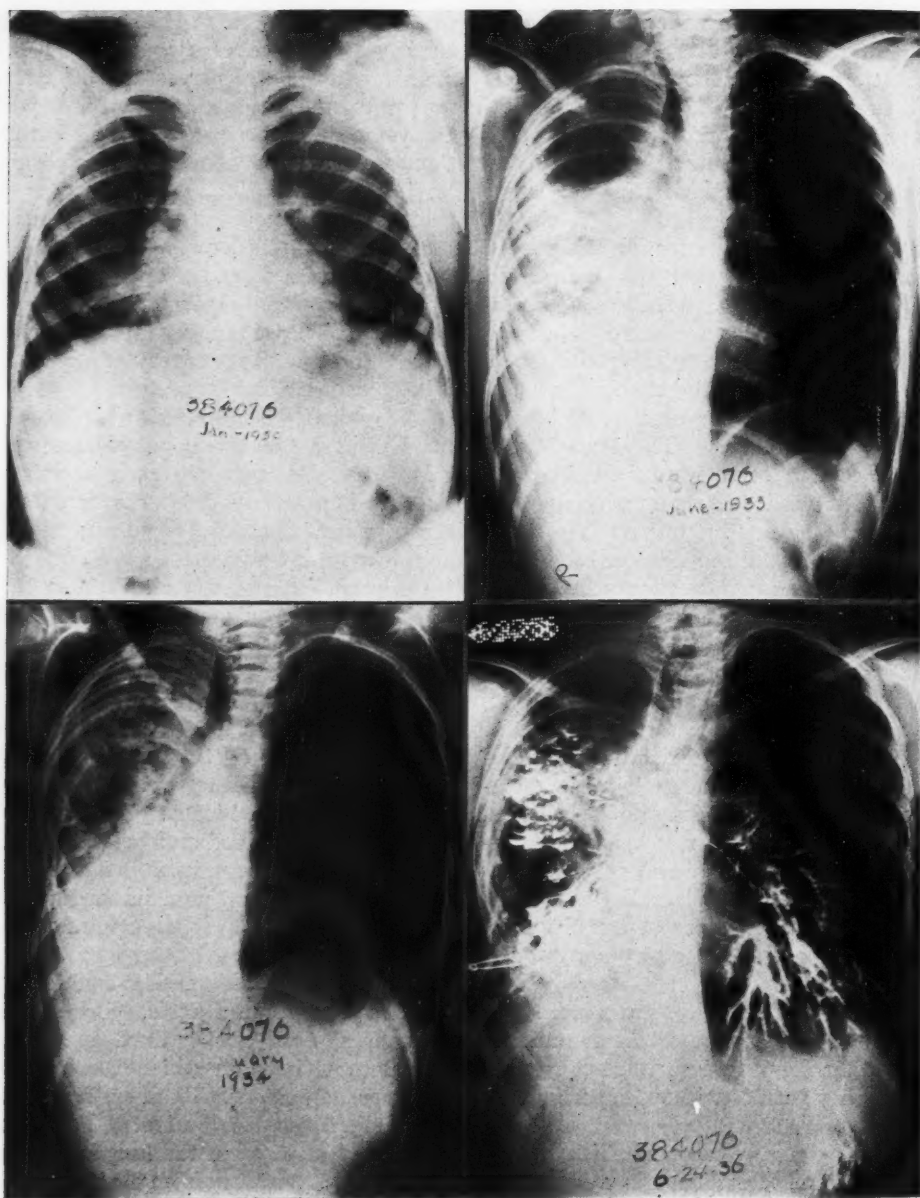


Fig. 1-A (upper left). Case 1. January, 1930: Inflammatory changes, right mesial base. No cystic changes evident. Normal upper lung. A film of February, 1933 (not illustrated): Increased inflammatory changes with accentuation of interlobular septa. No cystic areas.

Fig. 1-B (upper right). June, 1933: Large air-pocket or cyst in right apex (possible encapsulated pneumothorax after thoracentesis), partial consolidation of lower lung, partial deflation with mediastinal shift, multiple air-filled round defects in consolidated area.

Fig. 1-C (lower left). January, 1934 (after cautery): Disappearance of large apical area, multiple lesser air-filled defects remaining.

Fig. 1-D (lower right). June 24, 1936: Admission bronchogram: gross cystic bronchiectasis of the right lung, apparent recurrence of an apical pneumatocele, partial deflation of lung with mediastinal shift to the right.

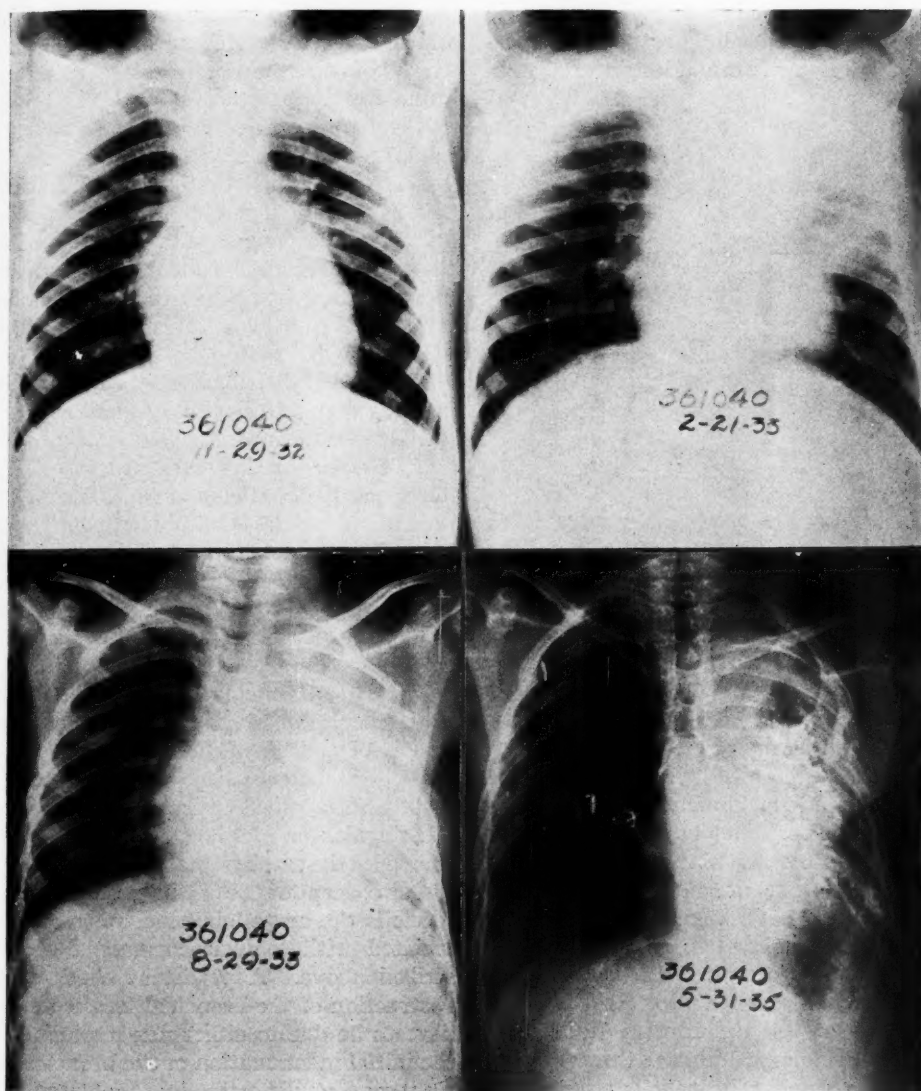


Fig. 2-A* (upper left). Case 2. Nov. 29, 1932: Normal chest.

Fig. 2-B (upper right). Feb. 21, 1933: Gross pulmonary infiltration left upper lung with suggestion of excavation in third interspace anteriorly.

Fig. 2-C (lower left). Aug. 29, 1933: Post-operative: obscuration of left lung, no deflation to permit mediastinal shift, thoracotomy ribs three and four in the axilla.

Fig. 2-D (lower right). May 31, 1935, on admission: Cystic bronchiectasis of left upper lobe and lingula, lesser involvement of inferior lobe: distortion of left stem bronchus.

roentgenogram) to contain a lobular pneumonia (without evidence of cysts), with the subsequent production of further pneumonia, and empyema, would not have been exposed to appreciable anthracotic dusts.

The presence or absence of anthracotic pigments can be valid as evidence of congenital or of acquired disease only when the conditions of life of the individual are considered.

The development of multiple cystic spaces, in the upper lung especially, subsequent to a known normal lung structure in

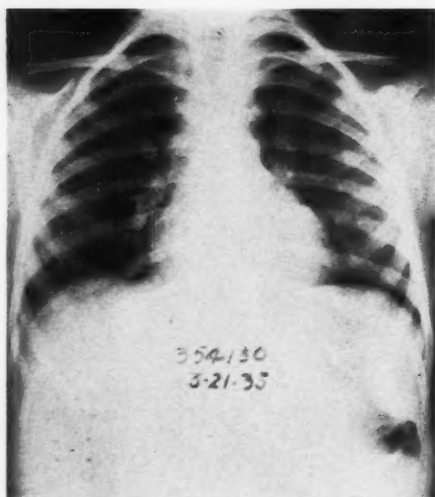


Fig. 3. Case 3. March 21, 1935: Normal chest.

that area, is notable. This is unquestionably an acquired cystic bronchiectasis subsequent to aspiration lobular pneumonia.

Case 2. N. F., male, aged 8 years. Patient had frequent colds and sore throat. Lung abscess developed at the age of 5, symptoms beginning two weeks after a tonsillectomy in November, 1932. Bronchoscopic drainage followed for eight months. External surgical drainage in July, 1933, with a secondary drainage three months later; subsequent broncho-cutaneous fistula. Recent exacerbation of symptoms with foul sputum and fever, loss of weight.

Roentgenograms made from November, 1932, to August, 1933, were reviewed through the courtesy of Dr. J. B. Flick, and Dr. J. T. Farrell, Jr., of Philadelphia.

Pneumonectomy (left) on June 21, 1935 (Dr. Alexander).

Pathologic Diagnosis.—Chronic purulent fibroid pneumonia with bronchiectasis and bronchiolar regeneration. No evidence of congenital or developmental changes. This

lung shows remarkably little anthracosis, and that which is present shows no peculiarity of distribution in respect to the bronchiectatic cavities.—Dr. C. V. Weller.

The post-operative course was uneventful.

Comment.—This cystic bronchiectasis, developing in a child with previously known normal lung structure, presented at the time of admission for definitive treatment a roentgen appearance closely similar to many so-called cases of congenital cystic pulmonary disease.

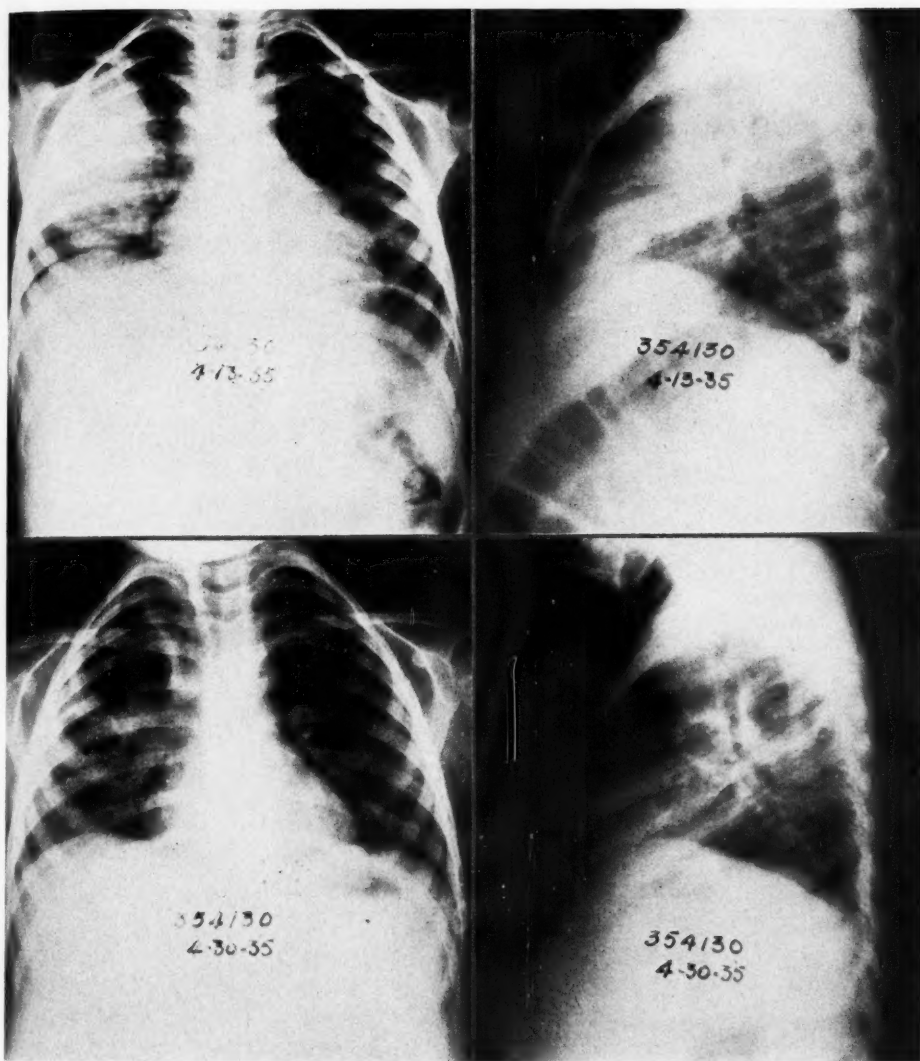
Again the distribution of anthracotic pigment seems to have no significance.

IV. *Pulmonary Pneumatocoele (Localized Alveolar or Lobular Ectasia).*—This fourth group of patients includes those who present a single, or a few contiguous grossly emphysematous alveoli. These ectatic air-spaces tend to increase in volume slowly or rapidly, and may assume massive proportions. Compression of portions of the surrounding lung will be associated.

The term "pneumatocoele" (πνεῦμα air, κήλη tumor) properly denotes the tumorous nature of the air-filled dilated or ectatic alveoli or lobular spaces. Both "alveolar" and "lobular" must be included because of the singular or multilocular character assumed by the emphysematous air-spaces.

Our concept of the origin of the pneumatocoele is the acute lobular emphysema associated with lobular pneumonia as described above. A persistent check-valve obstruction of the bronchial lumen we believe to be due to either non-resolution of the initial inflammation of the bronchus or a subsequent distortion by the dilated air-spaces. Several essayists have interpreted these changes as indicating the congenital origin of the lesion.

The intrapulmonary character is demonstrable by bronchogram or diagnostic pneumothorax. Symptoms, following resolution of the initial infection, are rarely more than an occasional cough and some dyspnea on exertion. The latter depends considerably on the size of the pneumatocoele and consequent pulmonary embarrassment. The marked focal emphysema may



Figs. 4-A and 4-B (upper). Case 3. April 13, 1935: Confluent lobular pneumonia, lateral inferior half of right upper lobe.

Figs. 4-C and 4-D (lower). April 30, 1935: Resolution of acute exudative process with appearance of multi-lobular area of excavation or pneumatic distention mid-lateral portion of upper lobe.

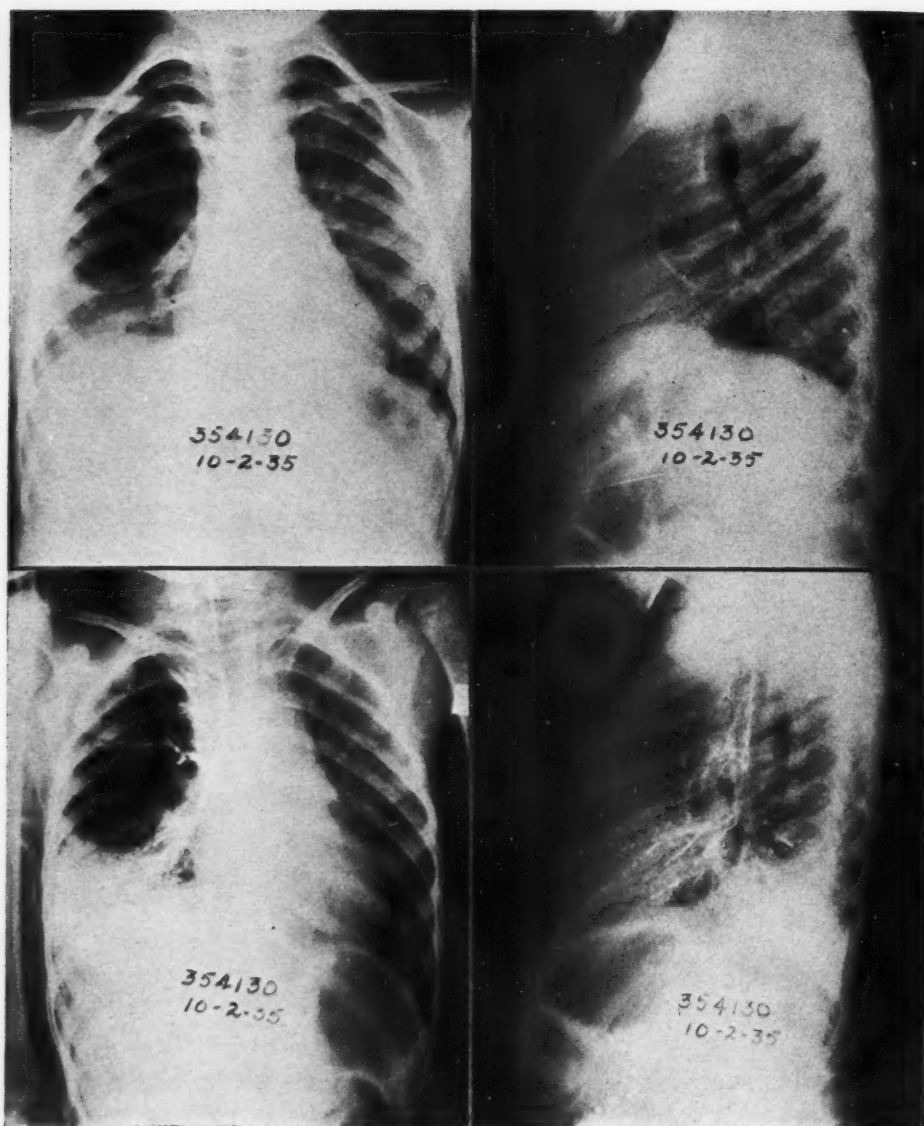
resolve without evident cause or may progress.

The following four cases present examples of this type.

Case 3. K. S., female, aged 4 years. Child has had purulent nasal discharge since whooping cough at the age of 2, with recurrent upper respiratory infection, last in February, 1935, followed by bilateral

otitis media, beginning February 25. A myringotomy was performed on the left side, March 3, bilateral March 8; mastoidectomy on the left, March 13. Patient suffered septic type of fever and pyelitis.

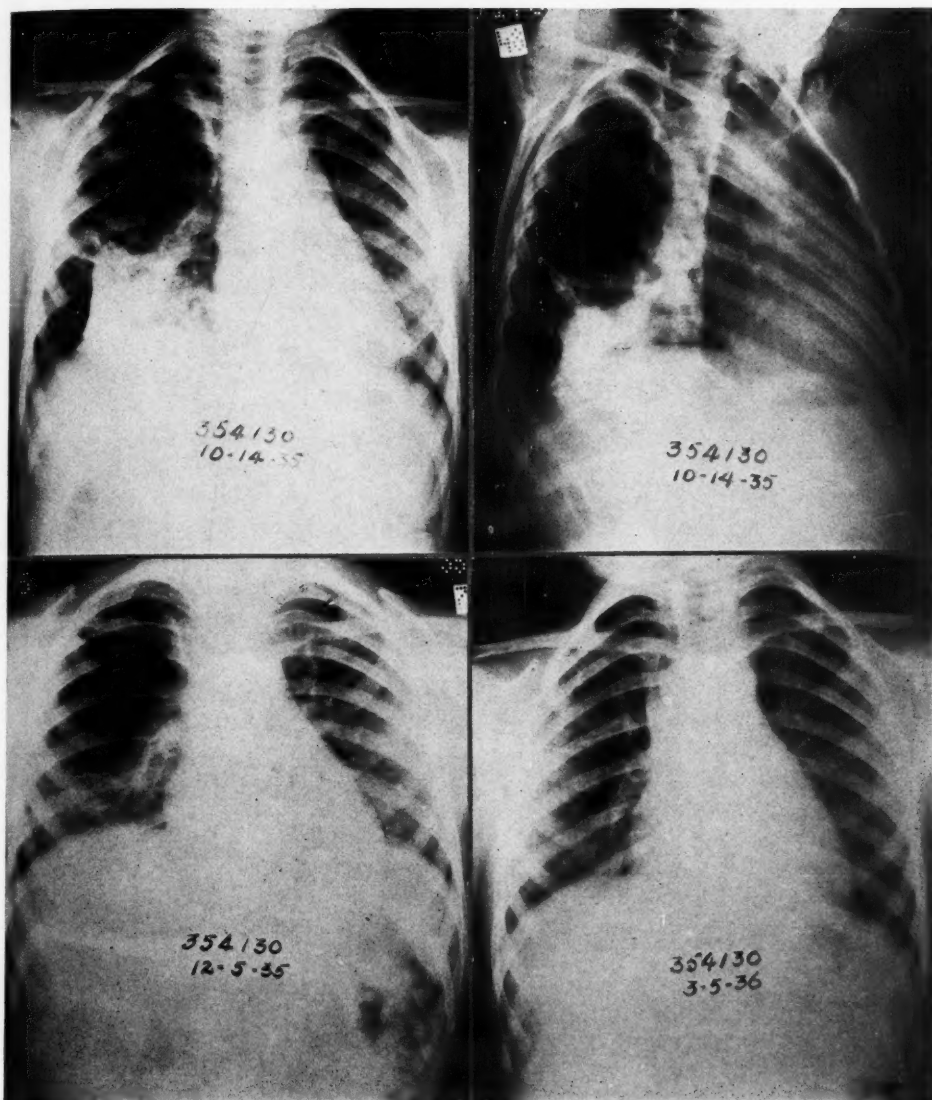
Positive agglutination, *B. abortus* and positive skin tests. Mild measles, April 5-12. Septic temperature continued slightly higher than before, reaching 106.7° F.,



Figs. 5-A and 5-B (upper). Case 3. Oct. 2, 1935: Thin-walled pneumatocele of increased size.
Figs. 5-C and 5-D (lower). Bronchogram demonstrated graphically the distortion of the bronchi and surrounding lung. Pressure pneumatocele, with block of dorsal ramus, eparterial bronchus.

April 12; cough and restlessness. Temperature dropped from 104° F. on the 15th to 98.6° F. April 16, 1936, not exceeding 102° subsequently; continuously normal after April 24. Sputum was never foul, nor were there any spirochetel organisms. Mantoux test was negative.

On July 15, 1935, the multilocular area had become a sausage-shaped pneumatocele in the right upper lung, with distortion of surrounding lung and compression of mesial apical lung tissue. There was no sputum, but occasional cough; moderate dyspnea.



Figs. 6-A and 6-B (upper). Case 3. Oct. 14, 1935: Induced diagnostic pneumothorax. Conclusive demonstration of intrapulmonary character of the pneumatocele, refuting clinical consideration of an encapsulated pneumothorax.

Fig. 6-C (lower left). Dec. 5, 1935: Evacuation of iodized oil; persistence of pneumatocele.

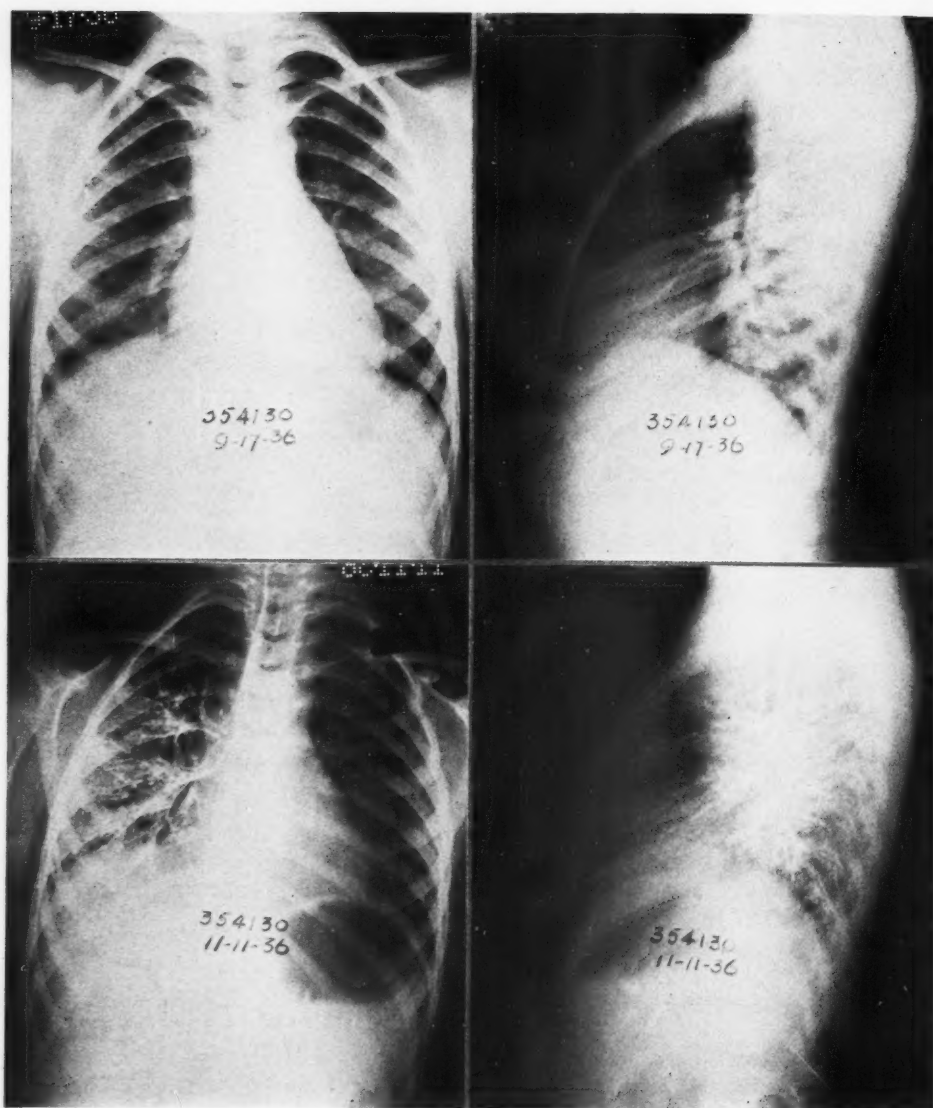
Fig. 6-D (lower right). March 5, 1936: Minimal irregularity in pattern of bronchovascular markings, right lung; disappearance of pneumatocele.

In October the child had some dyspnea on exertion but was otherwise well. Occasional dyspnea continued in December.

On March 5, 1936, a routine check-up was made. No change had been noted by parents except increased gain in weight

and disappearance of dyspneic attacks; roentgenographic disappearance of previous pneumatocele.

On Sept. 17, 1936, routine check-up showed child clinically well; no dyspnea, and essentially normal lung-fields.



Figs. 7-A and 7-B (upper). Case 3. Sept. 17, 1936: Normal lung-fields.

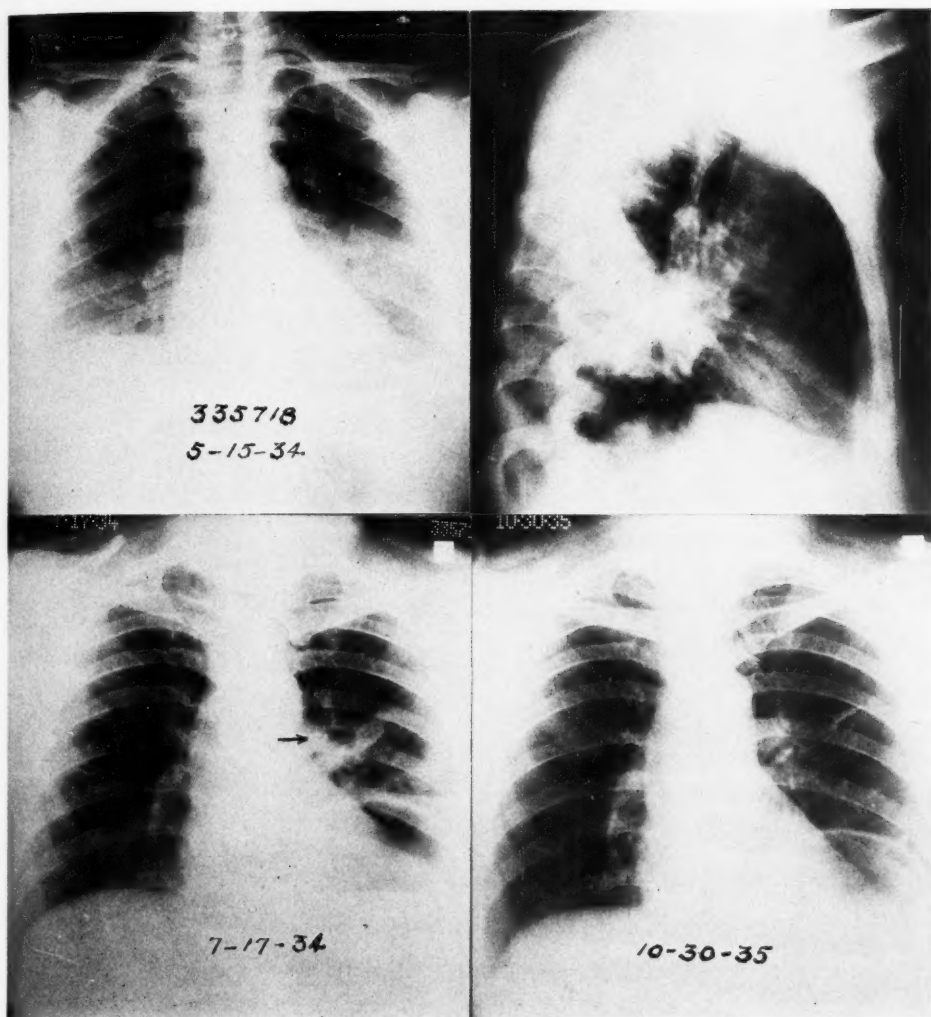
Figs. 7-C and 7-D (lower). Nov. 11, 1936: Normal bronchial tree. (Compare with Figs. 5-C and 5-D.)

Nov. 11, 1936, bronchial tree is normal and the child continues to grow normally.

Comment.—Positive evidence of a normal lung structure was available in this case prior to onset of the present illness. The development of the pneumatocele, at first multilocular, ultimately massive, has been traced, together with its spontaneous

regression. The resumption of normal bronchial pattern is striking in comparison with the earlier gross distortion effected by the pneumatocele.

There is no question here as to the absence of a congenital source. This case demonstrates graphically the production of localized cystic pulmonary disease follow-



Figs. 8-A and 8-B (*upper*). Case 4. May 15, 1934, on admission: Small diffuse pneumonic area in apex of left inferior lobe (area supplied by the dorsal branch of left stem bronchus) best seen in the lateral; no cystic areas.

Fig. 8-C (*lower left*). July 17, 1934: Regression of exudative lesion with pneumatocele in center; palsy of left diaphragm.

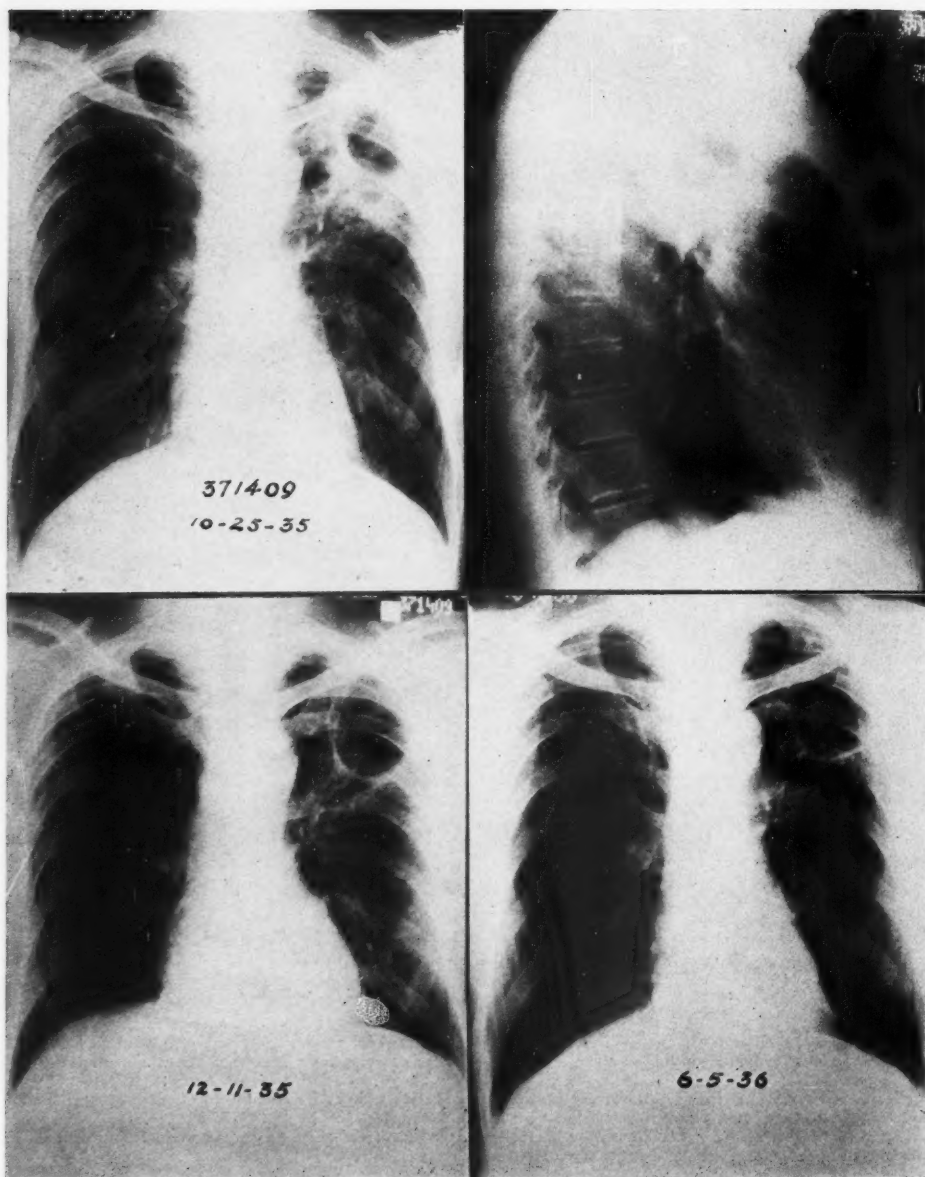
Fig. 8-D (*lower right*). Oct. 30, 1935: Persistent pneumatocele with moderate increase in size. Old scarring in area from previous aspiration pneumonia.

ing rapid resolution of lobular pneumonia in a previously normal lung.

Case 4. M. C., aged 47 years. Patient was well until one week after multiple tooth extractions, April 1, under gas anesthesia, when cough developed with profuse sputum. The case was diagnosed as aspiration pneumonia. Cough and sputum

(foul) had persisted; ease of fatigue, and discomfort in the left chest.

On admission there was a lobular pneumonia, left, as shown in roentgenograms. No acid-fast bacilli could be found on repeated examinations of sputum. Spirochetes and fusiform bacilli were reported on May 25, 1934. On May 20, 1934, there



Figs. 9-A and 9-B (upper). Case 5. Oct. 25, 1935, on admission: Excavation or air-filled cystic area in upper axillary portion of left lung with inflammatory changes about the periphery; some apparent displacement of nearby lung; peritruncal infiltration toward hilus; excavated or cystic area smooth-walled; moderate general pulmonary emphysema.

Fig. 9-C (lower left). Dec. 11, 1935: Regression of inflammatory reaction about wall of cystic area with increase in size.

Fig. 9-D (lower right). June 5, 1936: Pneumatocele of left apex increased in size.

had been temporary left phrenic interruption with a decrease in sputum, which dis-

appeared in June. Patient had no cough.

On Sept. 11, 1934, further regression of

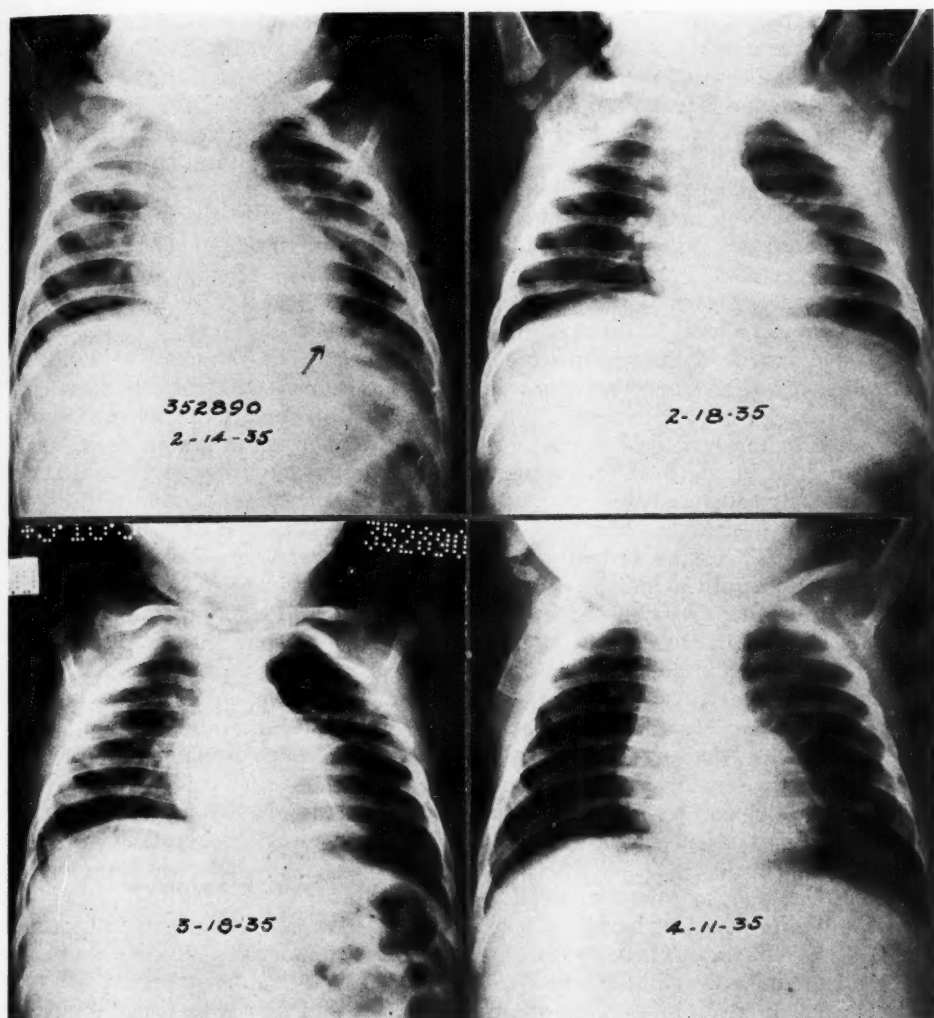


Fig. 10-A (*upper left*). Case 6. Feb. 14, 1935: Admission examination: resolving bronchopneumonia, greater involvement on left, with single pneumatocele or excavation in mid-left base; inflammatory changes about the wall.

Fig. 10-B (*upper right*). Feb. 18, 1935: Roentgenographic evidence of further resolution; persistent, smooth, thin-walled pneumatocele, left; secondary lesser area appearing mesially.

Fig. 10-C (*lower left*). March 18, 1935: Pneumatocèles increased in size.

Fig. 10-D (*lower right*). April 11, 1935: Further increase in size of multiple pneumatocele, left lung, following resolution of bronchopneumonia.

the inflammatory changes about the cystic area, with increased size of the pneumatocele were observed.

No cough or sputum was reported after September, 1934. Further increase in size of pneumatocele was presented in November, 1934.

On Dec. 30, 1935, the patient was clinically well. The function of the left diaphragm was returning. The pneumatocele persisted, and the peripheral scarring was minimal.

Comment.—A definite aspiration pneumonia, localized to the segment of the left

inferior lobe supplied by the dorsal branch bronchus was demonstrated by roentgenogram. This has been followed by resolution of the lobular infection, leaving a slowly progressive pneumatocele in the scarred area. The epithelization of a central necrosis from its partially obstructed bronchus or bronchiole must be considered, as well as the greater probability of localized emphysema of a central lobule with partial check-valve obstruction of the connecting bronchus or bronchiole. The progressive enlargement of the pneumatocele indicates the latter. A congenital source is highly improbable.

Case 5. J. L., male, aged 57 years. Patient suffered an injury to his nose eight years previously, followed by recurrent purulent nasal discharge. He has had chronic asthma since, the last attack of asthma being from July 15 to Sept. 7, 1935, followed in a few days by chills and fever lasting ten days. He had a cough with purulent, streaked sputum, beginning the fourth day, pleuritic pain in the left chest, weakness, sweating. He had had no previous x-ray examination of the chest.

Admission roentgenologic opinion, Oct. 25, 1935, was "lobular pneumonia in the left apex with excavation or pneumatocele, the latter more probable. Chronic asthma."

On Dec. 11, 1935, sputum was persistently negative for acid-fast bacilli on concentrated specimens. There were no spirochetal organisms. Guinea pigs were negative. On June 5, 1936, the patient still had asthma but no sputum. Final diagnosis was acquired pulmonary pneumatocele; chronic asthma.

Comment.—Intercurrent infection in a chronic asthmatic has here produced a cause for the development of a pneumatocele. The chronic asthma would afford intrapulmonary pressure changes contributing to an emphysema. No evidence is available as to the state of the lung prior to admission, but the sequence of events and subsequent course of the lung changes suggest an improbability of a congenital source for this lesion.

Case 6. G. D., female, aged 3 months.

Infant was well until acute onset of pneumonia in January, 1935, with slow resolution. She was admitted to the hospital on Feb. 14, 1935. On Feb. 18, 1935, she showed clinical improvement; by Feb. 20, 1935, cough and sputum had disappeared; by Feb. 23, 1935, x-ray examination showed resolution of the pneumonia; secondary pneumatocele increased in size; on March 18, 1935, asymptomatic; and on April 11, 1935, she had no symptoms—was clinically well.

Comment.—The progressive increase in size of the pneumatoceles, one developing before the other, in association with a resolving lobular pneumonia in an infant previously well, can hardly be associated with a congenital origin.

This case demonstrates in the sequence of changes what we believe to be the method of development of a pneumatocele from the emphysematous intervening lobules in a lobular pneumonia.

Films prior to the pneumonia are not available, but we do not believe that a theoretical congenital source should be preferred to the more probable acquired character. Without such prior films the roentgen diagnosis may neither include nor exclude the term "congenital."

DISCUSSION

The above cases show several varieties of cystic pulmonary disease developing after acute respiratory infection, two bronchiectatic and four with focal emphysema and little or no interstitial fibrosis.

Considerable emphasis has been placed by other writers on the probable predisposition to subsequent infection which pre-existent congenital abnormalities of the lung afford. We would call attention to the fact that in most of the cases reported by others, and in all of ours, the inflammatory changes have been greatest in the lung tissue intervening between the dilated airspaces. The "cystic" areas, themselves, have been unusually clear of evidence of infection, such as retained secretions or irregularity of wall. Our patients have had no appreciable sputum and little or no

cough after subsidence of the surrounding inflammation.

If the cystic areas were the source of the disease process, they should have remained in an inflamed and exudative state for some time after the surrounding process had subsided. Such has not been our observation.

SUMMARY

1. The term "congenital" is improper in a roentgen diagnosis of cystic pulmonary disease without film evidence of such a lesion at birth.

2. A congenital origin for cystic pulmonary disease is doubted as a valid premise in the majority of cases.

3. Cystic pulmonary disease may be further subdivided on the basis of cause and method of development as:

- I True congenital pulmonary cyst or cysts;
- II (a) Chronic interstitial pneumonitis with emphysema;
- (b) Chronic bullous emphysema;
- III Cystic bronchiectasis, and
- IV Pulmonary pneumatocele (localized alveolar or lobular ectasia).

4. The development of pulmonary pneumatocele has been demonstrated in four cases subsequent to an acute lobular pneumonia.

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DISCUSSION

DR. HENRY KENNON DUNHAM (Cincinnati): One of the modest men in the room said, "If they call on you, ask him whether he means this followed a pneumonitis or whether it followed pneumonia."

Peirce always said "pneumonia," and just exactly what "pneumonia" meant I think the Doctor would like to understand.

I am glad to come here to speak a word of praise of this presentation. I think it is timely and worth our while and the last speaker only said that he did not agree with all Dr. Peirce has said. Dr. Peirce does not agree with all he said himself! The point is that he has asked a question much more than he has told you something. He has shown you what he found. He has said, "Is our old solution right? Have we

not been talking glibly about congenital cysts when we do not know much about congenital cysts? Had we not better go a little slowly and find out how much of this is due to one thing and how much to another?"

The chief scientific part of this paper is the presentation of facts—a presentation of a more modern theory and the question of how much of the old we are going to discard.

I am not here to answer that question any more than is Dr. Peirce, but you have noticed just what he has been talking about, the same as we have at our clinic. We are asking these questions.

And the next question that has to be asked is, What are you going to do about it?

DR. LOUIS H. CLERF (Philadelphia): My frequent appearances on the rostrum this morning would give the impression that this is my lucky day. It certainly is not when it comes to a discussion of cystic disease of the lung and pulmonary pneumatocele.

I enjoyed this paper. It gives one much to think about. I am in favor of pedestal-shakers and iconoclasts, for they aid greatly in getting us to revise our notions concerning conditions about which we know too little. The term "congenital cystic disease" has been employed often when the history and clinical findings did not entirely warrant such a diagnosis. The term often has been loosely applied. I am certain that if we bear in mind what Dr. Peirce has stated this morning, it will be necessary to restudy certain of our cases and revise diagnoses.

DR. D. DUDLEY KRUPP (Martins Ferry, O.): The speaker, it seems to me, used the terms "cyst" and "pneumatocele" synonymously. As a roentgenologist and pathologist, I wish to state that there is a vast difference between the two terms; therefore, the roentgen differentiation should be in accordance with the pathologic findings. In the cyst, we find a cavity

that is filled with fluid, usually of a viscid consistency. In the pneumatocele, we find an air pocket, which is caused by air distending one or more bronchioles. A cyst may be congenital, but a pneumatocele is acquired.

DR. CARLETON B. PEIRCE (closing): In regard to the question about "cyst" or "pneumatocele," we have tried very carefully to guard in the text the use of the term "cyst." (I may have misspoken.) If such a term in reference to these aerated spaces has been used, it has been qualified by saying "air-filled cystic space" or "apparent cyst," because of the fact that on the basis of accurate terminology we do not consider them cysts.

We emphasized in the opening paragraphs of the paper that there is no objection to the use of "cyst" in those individuals within whom such spheroid spaces contain fluid. The one case which I mentioned having seen with Dr. Rowe (he has told me to-day that this patient is now a senior medical student), the few cases which Kunz cited, and others reported subsequently are unquestionably congenital pulmonary cyst.

I would again emphasize that we, personally, have not seen any, nor do we find reported more than two cases of "honey-comb lung" or multiple cystic pulmonary disease in which both air-filled and fluid-filled "cystic" spaces were found simultaneously. Logically such a state of the lungs would be expected in congenital disease with rupture and subsequent aeration of some of the cysts. We cannot believe that multiple congenital pulmonary cysts could have ruptured universally and become aerated.

If all cases presenting these multiple, air-filled "cystic" spaces are "congenital" cystic pulmonary disease, why are there so few individuals who show both air-filled and fluid-filled spaces?

The cases of multiple involvement which we present in the paper, and which I omitted this morning because of the shortness of time, have been referred to by

Dr. Chamberlain.¹ They illustrate our opinion on the above question. (Cases 1 and 2 presented.)

In these we believe that the lobular pneumonia has been accompanied by multiple alveolar to lobular ectasia of intervening areas and sufficient suppurative process to induce the pneumonitis and chronic bronchitis to cause the condition to be persistent and progressive.

In the other four we have no tissue studies for pathologic proof. Fortunately for the patients, unfortunately for us, they are clinically well. But we do not believe their condition can be of congenital origin.

The terminology in the literature is confusing. We have attempted to clarify our concept of the mechanics of production of these changes on whether they be the solitary air-tumor or "pneumatocele" (probably a lobular ectasia), multiple involvement (alveolar ectasia, widespread peripheral bronchiectasis, or either, associated

with interstitial pneumonitis), or the single true congenital cyst filled with fluid. On close analysis, most of the cases previously reported would seem to fall in our Groups II and III.

We are honored by Dr. Clerf's comments. I hope I am not too much a nihilist or a "pedestal-shaker." But the question, "Can all these be congenital in origin?" has actually bothered us. Consequently when the youngster (Case 3) presented the sudden development of pneumatocele after a known pneumonia in a previously normal lung, we were further aroused. Her subsequent story has confirmed us in our skepticism. The others have served as additional evidence in support.

As Dr. Dunham has said, we are asking the question of ourselves as well as of others. We know that in the past we have made the diagnosis "congenital cystic pulmonary disease" without concern. We now believe that we were in error as to the "congenital" character.

¹Dr. Chamberlain's discussion was not returned for publication.

RADIOGRAPHIC APPEARANCES ABOUT THE SHOULDER JOINT, WITH ESPECIAL REFERENCE TO CYST-LIKE SHADOWS

CLINICAL CASES

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From the Department of Surgery and the Division of Radiology, Department of Medicine, University of Rochester School of Medicine and Dentistry

FOR several years we have been consulted in regard to queer appearances in roentgenograms of the bones about the shoulder joint, and especially in those of the upper end of the humerus. Physicians have often been confident that they were dealing with cystic changes in the humerus, clavicle, or scapula, with giant-cell tumors at the upper end of or in the tuberosities of the humerus. On occasion there have been enough symptoms and signs, together with these radiographic appearances, to warrant exploratory incision

by the attending surgeon. The fact that these unusual films also may be obtained after injury to the shoulder has led to suits for compensation in some instances.

Careful study of the films before and after a negative exploration in one case led us to the consideration that perhaps the position of the bones was not that which we had been accustomed to interpret. Repeated observations in dislocations of the humerus with consequent abnormal positions of the bones have served to substantiate this view. Following some forms of trauma the patient is not able to get his shoulder into an ideal contact with the radiographic plate and distortion of the usual roentgenogram is the result. In other instances when long continued disuse of the shoulder (especially in adduction) has supervened the calcium has been withdrawn from the bony structures about the joint and in consequence the thinner areas appear as cystic spaces in contrast to the more dense cortex. Several examples of these unusual appearances are here presented with brief histories under each illustration (Figs. 1-7).

When we had acquired experience from observations on some of our clinical cases, it seemed advisable to determine what roentgen-ray appearances might be expected when the humerus was rotated through varying positions. This subject will be presented in the paper by one of us (W. W. F.) which follows.

From a study of these patients it is apparent that trauma, infection, and disuse may cause symptoms referred to the shoulder joint. Roentgen-ray examination may reveal peculiar appearing areas in the bones about this joint. The physician must be guarded in his interpretation of these films. The diagnosis should not be



Fig. 1. Case 1. C. R., No. 83,333, female, 58 years of age, was admitted to the emergency department on Dec. 6, 1933. She had fallen down the cellar stairs, striking the left shoulder and left side of her head. There was pain on movement of the shoulder. Examination showed a forward displacement of the left shoulder. The arm was held close to the side. There was a swelling over the outer third of the clavicle. The lower angle of the left scapula showed winging. A fracture could be palpated at the outer third of the clavicle. Roentgen rays showed a complete fracture of the clavicle, outer third, with overriding of the fragments. A peculiar cyst-like appearance was noted in the head of the humerus (as shown). Reduction and fixation were done in the usual way. The result of the treatment was excellent.



Fig. 2. Case 2. C. S., No. 84,298, male, 38 years of age, was admitted to the Emergency Department on Jan. 5, 1932, with a subglenoid dislocation of the left humerus. He was under the influence of alcohol and knew nothing about the cause of his accident. Roentgen rays showed a dislocation of the head of the humerus with a cyst-like shadow. After reduction this cyst-like area was no longer apparent.

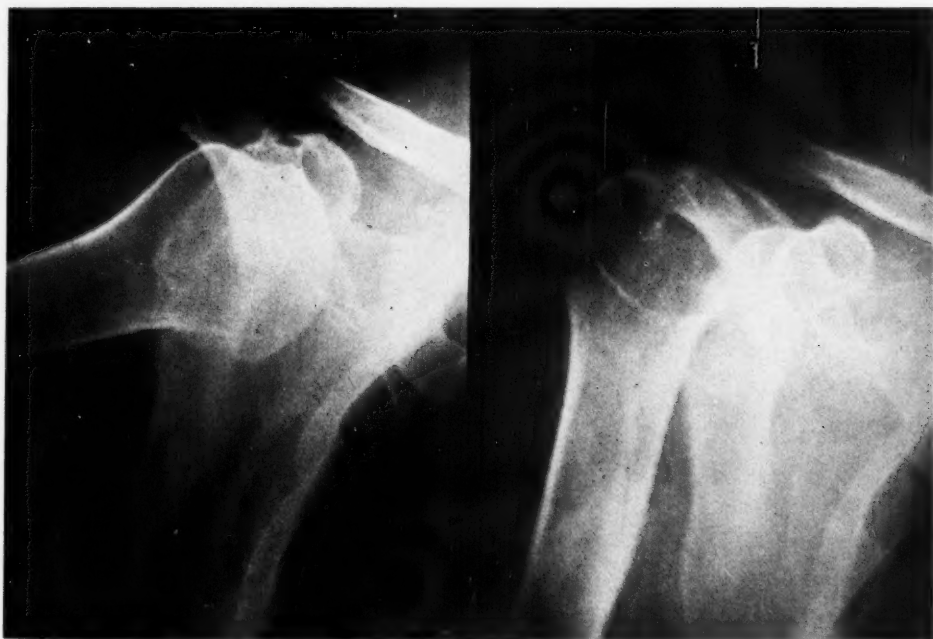


Fig. 3. Case 3. C. K., No. 94,788, male, 71 years of age, came to the Emergency Division on Oct. 14, 1934. He had slipped on the top step of a stairway and had fallen down fourteen steps, hitting on his right shoulder. There was a subcoracoid dislocation with fracture of the inner third of the clavicle. This was confirmed by roentgen ray. After reduction there was observed the appearance of a cyst-like shadow at the upper end of the humerus.

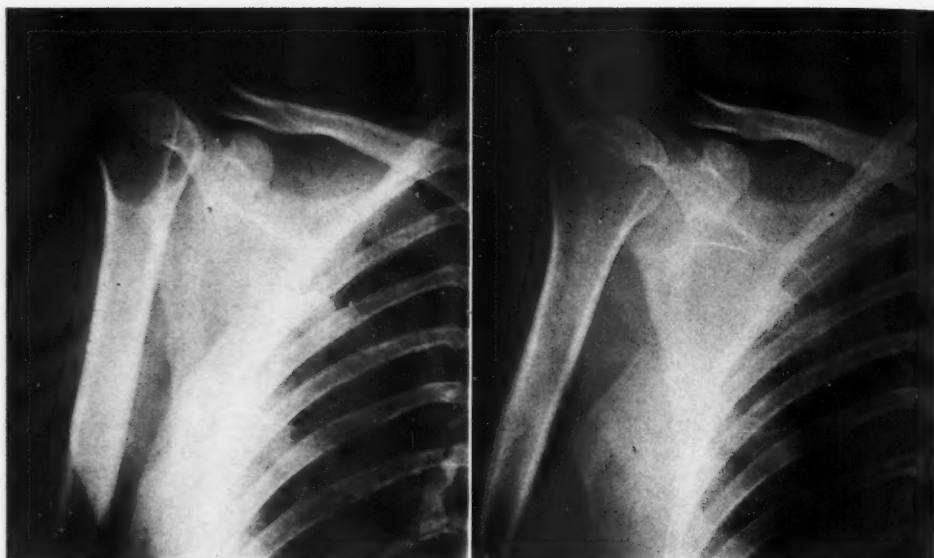


Fig. 4. Case 4. M. K., No. 69,917, female, 33 years of age, was admitted to the Strong Memorial Hospital on Feb. 2, 1933, complaining of pain in the right shoulder. Six years previously she began to have severe aching pain in the right shoulder and right side of the neck, not relieved by treatment. There was no history of focal infection or trouble with other joints. On examination she showed atrophy of the right supraspinatus, infraspinatus, and deltoid muscles. There was point tenderness at the tip of the acromion process. Motion of the right shoulder showed good range but was slightly painful. Roentgen-ray examination of the humerus showed what appeared to be a large bone cyst in the head of the humerus. There was a calcified spot in the region of the subdeltoid bursa. In another view the cyst-like area did not show well but there appeared to be a loss of density of the greater tuberosity and the calcified areas in the bursa were more pronounced.



Fig. 5.



Fig. 6.

Fig. 5. Case 5. L. C., No. 44,274, female, 52 years of age, fell on the ice March 25, 1934, striking her left shoulder. There was immediate pain and swelling of the shoulder. Examination showed exquisite tenderness about the head of the humerus, swelling, and ecchymosis. Roentgen-ray examination revealed a frac-

(continued from previous page)

ture of the surgical neck of the humerus. There was a shadow with a definite outline which suggested a cyst or giant-cell tumor. Subsequent roentgen-ray films from different angles proved that this appearance was due to a rotation of the greater tuberosity into an anterior position.

Fig. 6. Case 6. H. C., No. 74,066, male, 48 years of age, was admitted to the Orthopedic Department with a history of pain in the right shoulder of five months' duration. There was no history of injury. General examination was negative. There was slight tenderness beneath the tip of the right acromion process. The right shoulder could not be abducted beyond 90° without pain. External rotation was about three-fourths normal. Roentgen ray examination showed a decrease in density about both tuberosities. There was also what appeared to be a cystic area in the base of the coracoid process. A diagnosis of subacute subdeltoid bursitis was made. The appearances in the humerus resulted from disuse calcium withdrawal. The cystic appearance of the coracoid was due to the position. It disappeared on views taken from another angle.



Fig. 7. Case 7. A. P., No. 81,257, female, 43 years of age, was seen here first on Oct. 17, 1933. She had been in an automobile accident on Nov. 28, 1931. At that time she was holding out her left hand to indicate a left turn when another car crashed into her auto from behind. She was thrown against the door. There was soreness and stiffness of the shoulders and neck that night. She was under the treatment of her local doctor for two months following this without relief. In January, 1932, roentgen ray films were taken. Pain had been present in her shoulder and neck ever since the accident. She had not been able to use her left arm for even the lightest movements without pain. She could not get her left hand up to her hair. Pain kept her awake at night. There had been shortness of breath, nervousness and occasional hysterical episodes.

Examination revealed an obese woman apparently in good health. General examination was normal for her age. The left shoulder was painful around the outer end of the clavicle and the acromion. All motions were apparently much restricted, especially abduction. There was atrophy of the left upper arm muscle. No sensory or vasomotor changes were noted. Roentgen-ray examination showed areas of decreased calcium content over the head of the humerus. There was a blotchy distribution of calcium all around the shoulder joint, in the outer end of the clavicle, and in the scapula as well as in the humerus. There was slight evidence of arthritic change around the glenoid region.

This patient had been told that she had a giant-cell tumor or a cyst of the upper end of of the humerus. There was a lawsuit involved with the company which carried auto insurance on the other machine. The claim was made that trauma had caused development of a cyst or giant-cell tumor in the injured humerus.

reached until a careful appraisal of all symptoms and signs has been made. If the roentgen rays seem to offer a possible diagnosis of bone cyst or giant-cell tumor, it is well to remember the characteristics of these lesions. The bone cyst is likely to be in the diaphysis below the epiphyseal line. The cortical bone over it becomes thinned out by pressure. The picture is of a clean-cut area visible in every position of the bone. The giant-cell tumor of the humerus occupies the angle between the upper and lower epiphyseal lines. It is of a peculiar type in the humerus, the so-called chondromatous giant-cell tumor described by Codman (1). It differs from the giant-cell tumor in other bones by the fact that it does not actually destroy the bone to the articular cartilage but is restricted to the

region of the greater tuberosity. This breaks the rule for giant-cell tumors in other bones because the tumor does not extend into the head of the humerus much beyond the epiphyseal line. There is present also a thickened strut of normal cortical bone just below the tumor. In any case in which a doubtful cyst-like lesion is exposed by the roentgen-ray examination, the influence of position should be considered. One of us (W. W. F.) has made a thorough study of the radiographic appearances about the shoulder joint from many different angles. The results of this study will be presented in another paper.

REFERENCE

- (1) CODMAN, E. A.: Epiphyseal Chondromatous Giant-cell Tumors of the Upper End of the Humerus. *Surg., Gynec. and Obst.*, 1936, **52**, 543-548.

THE EFFECT OF POSITION ON THE PRODUCTIONS OF CYST-LIKE SHADOWS ABOUT THE SHOULDER JOINT

By WALTER W. FRAY, M.D., Rochester, N. Y.

THE shoulder as a joint of the universal type displays a wide range of motion in all three planes of space. The degree of its mobility is reflected by the range of flexion and extension of the arm through 180 degrees (hyperextension adding about 45 degrees of additional mobility), by the range of abduction through 90 degrees with an additional 90 degrees if rotation of the scapula is taken into consideration, by the extent of horizontal abduction and adduction through 90 degrees, and finally by the degree of internal and external rotation, which in a position of horizontal abduction amounts to about 90 degrees. The radiographic appearance will, of course, vary with the position of the arm and shoulder employed during the technic. It is the purpose in the present study to relate the radiographic appearance with the anatomic position and to demonstrate the manner in which misinterpretation may arise due to the employment of faulty technic or to a lack of familiarity with normal roentgenologic appearance when a restricted or an unusual technic must be followed.

The common texts describing x-ray technic present a confusing picture to the novice in this field, chiefly because of the diversity of technics described. The positions recommended by Hirsch (1), 1920, are: anteroposterior films of the shoulder secured on a 45° angle block. The arm is placed at the side of the body with the forearm midway between supination and pronation. In this position, therefore, the thumb is uppermost and the internal epicondyle points medially and slightly posteriorly. With the shoulder in this position, Hirsch states that the central ray should be directed from a point four inches above the shoulder joint if the shoulder joint itself is the joint of main interest; while if the acromioclavicular joint is desired, the position of the patient remains

the same but the central ray is directed from a point four inches below the joint. Secondly, Hirsch recommends a postero-anterior position with the arm held in a true anatomic position, that is, with the palm of the hand held in the supinated position. A third position recommended by Hirsch is the infero-superior position, placing the film or cassette on top of the shoulder and directing the rays upward and inward through the axilla. Jerman (2), 1928, describes two positions (postero-anterior and anteroposterior), the anteroposterior position with the patient supine, the arm adducted to the side of the body, and the hand resting over the abdomen. The illustration, however, which accompanies the description of the position does not show the arm in the internally rotated position which results when the hand is placed over the abdomen. The postero-anterior position is described by Jerman with the patient prone, the face being turned toward the normal side, and the arm adducted to the side of the body. The focus is stated to be over the outer end of the clavicle. Rhinehart (3), 1936, recommends the true anteroposterior anatomic position as the standard position if there are no bandages present and pain does not prevent its use. He states that a lateral film is obtained, at least as regards the humerus, when the arm is internally rotated, by throwing the hand in a pronated position over the chest. Special technics are mentioned by Rhinehart in order to obtain lateral films of the upper humerus in the event that there are no restricting bandages and excessive pain is not present. These special technics involve placing the film either in the axillary region, taking a supero-inferior type of film, or placing the film on top of the shoulder when the arm is abducted from the side of the body, the central ray entering through the axillary region at right-angles to the film.

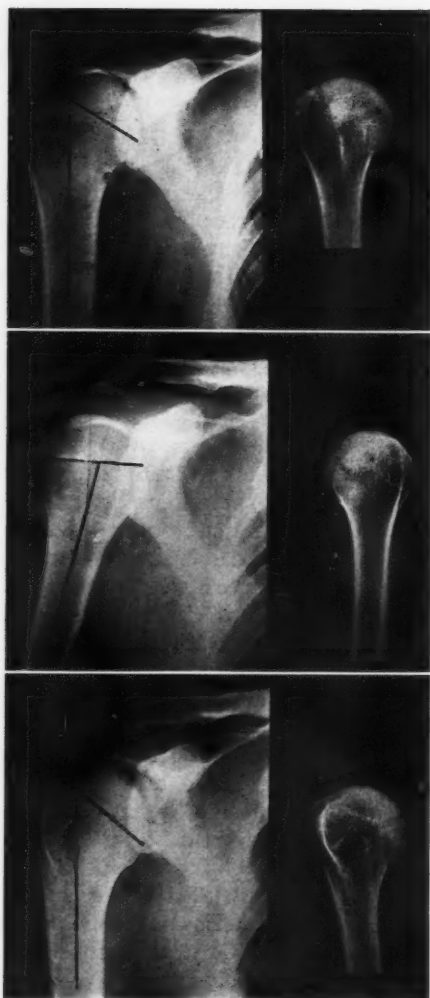


Fig. 1. Effect of internal and external rotation. Comparison of shoulder films of normal individual with dried specimen.

(A) Anatomical position. The greater tuberosity is brought into full salience along the outer aspect of the upper humerus. The lesser tuberosity is seen distinctly, due to its position on anterior aspect of the bone. The articular convexity faces upward and medially. The epiphyseal line forms an acute angle of 55-60° with the long axis of the shaft.

(B) Extreme internal rotation. The lesser tuberosity is outlined in full salience along the inner aspect of the upper shaft, the greater tuberosity disappearing due to its anterior position. The head faces upward and the epiphyseal line forms a slightly obtuse angle with the long axis of the shaft.

(C) Extreme external rotation. The greater and lesser tuberosities are partly superimposed upon one another along the outer aspect. The articular convexity faces strongly inward and the lower articular margin of the head lies on the same plane as the lower articular margin of the glenoid.

some one region or portion of the humerus or scapula.

ANALYSIS OF EFFECTS OF ROTATION ON ROENTGENOLOGIC APPEARANCES WITH AND WITHOUT THE ABDUCTION OF THE ARM

Changes Produced by Rotation when Arm is Held in the Adducted Position.—The films were obtained with the patient supine. For the first exposure the arm, placed parallel with the long axis of the body, was rotated inward, with the forearm placed between the back of the patient and the table top in a position of hyperextension (Fig. 1). This position brings the bicipital groove near the medial aspect of the upper humerus. The position is an unusual one, the lesser tuberosity being seen in profile exceptionally well. The greater tuberosity, due to its anterior position, is poorly visualized except for its margin at the bicipital groove. The lower articular margin of the head is noted at the mid-level of the glenoid. The main articular portion of the head is directed cephalad with the epiphyseal line running at a right-angle to the shaft of the bone or tilting slightly away from the scapula side. As the humerus externally rotates to the usual anatomic position, the bicipital groove shifts toward the lateral aspect of the bone and the greater tuberosity is visualized in profile (Fig. 1). The outline of the lesser tuber-

We have taken a series of 18 films of a normal shoulder to illustrate the changing character of the x-ray shadows with alterations in position. We have purposely taken these films through the full range of flexion and extension, adduction and abduction, and internal and external rotation. From this study we have gained much in experience and we feel that the establishment of a routine type of technic is highly desirable for the average type of case. Special positions have been found to be advantageous when a restricted study is desired, concentrating attention particularly upon

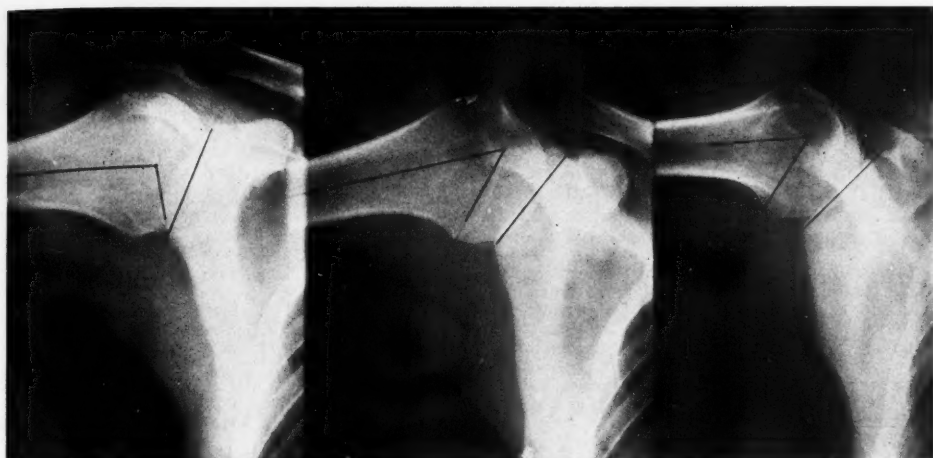


Fig. 2. Effect of rotation at 90° abduction.

(Left) Extreme internal rotation. Plane of epiphyseal line forms an obtuse angle with the shaft.

(Middle) Anteroposterior position without rotation. Plane of epiphyseal line forms an acute angle with shaft.

(Right) Extreme external rotation. Plane of epiphyseal line forms an acute angle with shaft. Note that the effect of rotation upon the humerus is practically identical with that observed in adduction. The scapular relations vary, however. The base of the coracoid appears as a cyst during internal rotation. This process is brought out into good relief by external rotation and is thrown upward between the shadows of the outer clavicle and acromion. The head covers larger portions of the acromion as external rotation is employed, the extent of abduction remaining constant.

osity is largely lost except for an indistinct margin at the bicipital groove. The lower articular margin of the head is observed at the level of the junction of the lower and middle third of the glenoid. The plane of the epiphyseal line forms an angle of approximately 60 degrees with the long axis of the shaft.

The position obtained when the hand is placed over the abdomen with the arm to the side is an intermediate one between the anatomic anteroposterior position and extreme internal rotation. The anatomic relationships as shown in the radiograph resemble the anteroposterior film in general appearance, but the greater tuberosity is not observed in full salience. There is always the danger of the arm being taken in a position with some forward flexion, a condition which favors the production of confusing shadows. The angle between the plane of the epiphyseal line and the long axis of the humerus changes from 60 degrees for the true anatomic position to 75 degrees for the partially internally rotated position.

With extreme external rotation the margins of the bicipital groove become sharply defined at the extreme outer aspect of the bone, the greater tuberosity having rotated to a posterior position and is seen only partly in profile (Fig. 1). The angle between the epiphyseal line and the shaft of the humerus decreases to approximately 50 degrees. The lower articular margin of the head lies on practically the same plane as the inferior margin of the glenoid.

Effect of Rotation when Arm is Held in 90° Abduction with Humerus at Right-angle to the Long Axis of the Body.—Internal rotation changes the relationship between articular surfaces of the head and the glenoid, but the general appearance of the upper end of the humerus is much the same as that observed when the arm is adducted to the side of the body except that the degree of internal rotation is somewhat less and the lesser tuberosity is not brought into full salience as a result (Fig. 2). As external rotation is employed, the changes observed at the upper humerus are similar

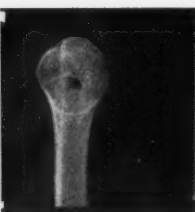


Fig. 3.

Fig. 3. Anatomical basis for appearance of roentgenologic shadows produced by combined movement of flexion and internal rotation.

(Left) Humerus oriented at 45° forward flexion and 90° internal rotation. Note that the plane of the epiphyseal line (indicated by black line) lies parallel to the film surface (indicated by white line). The head looks directly downward toward the film.

(Right) A radiograph obtained with the central ray as shown by arrow. The articular margins of the head are cast upon the film as a circular shadow, the margins simulating the walls of a cyst. The epiphyseal line is absent. The margins of the greater and lesser tuberosity are superimposed upon those of the head to permit further confusion. This position of the arm is obtained whenever the arm is strapped across the chest in a Velpeau bandage.

Fig. 4. Anatomical basis for appearance of roentgenologic shadows produced by combined movement of flexion and external rotation.

(Left) Humerus oriented at 45° forward flexion and 90° external rotation. Note that the epiphyseal line (indicated by black line) is now perpendicular to the film surface (white line). The articular surface of the head is directed cephalad.

(Right) Radiograph obtained with central ray as shown by arrow. The epiphyseal line being at a right-angle to film surface casts a shadow across the extreme upper end of the shaft. The convexity of the head is directed away from the shaft. The lesser tuberosity casts a pointed salience along the lateral aspect of the bone while the shadow of the greater tuberosity is largely lost, being visualized through the upper shaft.

to those seen when the arm is held adducted to the side.

When the arm is directed vertically upward in a position of extreme abduction, rotation becomes more limited with less marked changes observed at the upper end of the humerus.

Effect of Abduction on Relations of Scapula.—While the general appearance of the humerus remains much the same during abduction and adduction (provided the same degree of rotation is maintained), the relations between the shadows cast by the various portions of the scapula, clavicle, and humerus show marked changes. With the arm adducted to the side, a line drawn between the superior and inferior glenoid tubercle is directed nearly vertically downward and the vertebral border of the scapula runs nearly parallel with the spine. The coracoid is visualized very poorly, its base casting an oval shadow resembling the bony outlines of a cyst while the tip of the process overlies the glenoid. The scapular spine lies at a high level above the plane of the coracoid. The supraspinous fossa is poorly visualized, measuring less than a centimeter in width, due to the angle at

which its outlines are cast on the film. The acromion at its outer end partly overlies the humerus. The outer end of the clavicle appears relatively slender and straight, its angle being entirely missed in this position. With abduction the shadow of these structures shows a shift in relationship (Fig. 2). The coracoid overlies the scapular spine and the base of the acromion when the arm is internally rotated. It tends to be thrown above the acromial level as the arm undergoes external rotation and the outer end of the clavicle presents its angle or curve with increasing external rotation. With extreme external rotation, the coracoid is observed between the base of the acromion and the outer end of the clavicle. The outer portion of the acromion overlies a larger portion of the shadow of the upper humerus than when the arm is abducted. This effect is likewise increased by external rotation. In the position of extreme abduction with the arm directed vertically upward, the coracoid—both its base and process—is well visualized, the shadow being noted medial to the plane of the scapular spine, with its process directed upward and laterally near the shadow of the acromioclav-

vicular joint. The acromion is visualized only through the humerus except for the angle. The plane of the glenoid forms an angle of more than 45 degrees with the

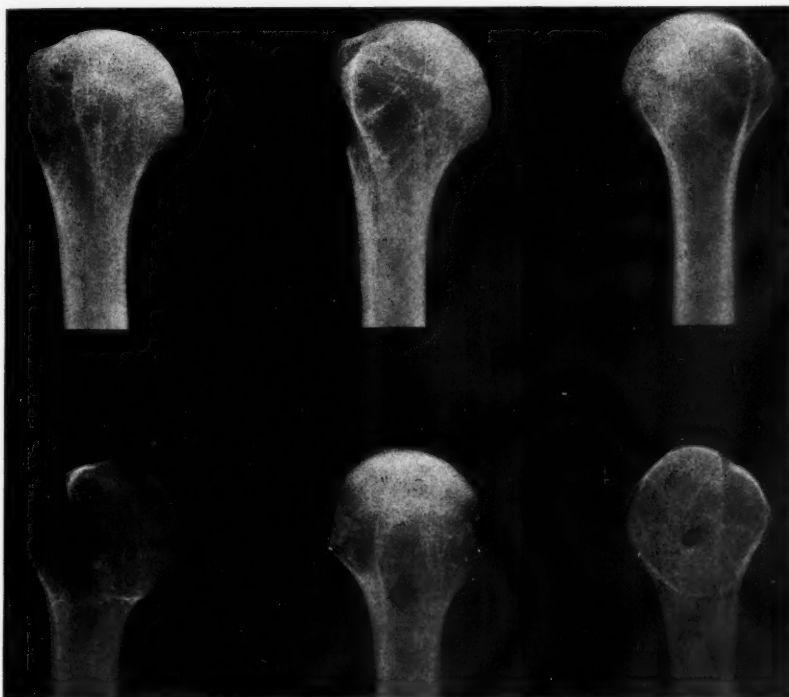


Fig. 5. Films of bone specimen (right humerus) showing effect of change in position on roentgenologic appearances. In each case the bone is oriented so that the right side of the humerus faces the axillary region (medially).

(Upper left) Straight anteroposterior or anatomical position. The greater tuberosity lies in maximum salience on the outer aspect of the bone. The lesser tuberosity is indistinctly visualized (because of its anterior position) just below the epiphyseal line over the central portion of the upper shaft. The head faces medially.

(Upper central) Extreme external rotation. The greater tuberosity has been turned to a more posterior position while the lesser tuberosity may be identified far laterally overlying a portion of the greater tuberosity. The head faces medially.

(Upper right) Extreme internal rotation. The lesser tuberosity is brought into salience along the medial border while the shadow of the greater tuberosity is largely lost being visualized only through the upper shaft because of its anterior position. The convexity of the head now faces away from the axilla.

(Lower left) Forty-five degrees of forward flexion without rotation. Position of the arm is similar to upper left except for flexion. The shadow of the lesser tuberosity is thrown upward in the notch between the greater tuberosity and the head. Note the tendency for the upper humerus to appear cystic.

(Lower middle) External rotation (90°) and forward flexion (45°). The lesser tuberosity is cast into salience on the lateral aspect of the bone while the greater tuberosity is visualized indistinctly through the upper shaft due to its posterior position. The head faces vertically upward.

(Lower right) Internal rotation (90°) and forward flexion (45°). The head looks downward toward the film, its articular margins casting a shadow simulating a cyst. The two tuberosities are superimposed over the circular outline of the head and portions of their margins may coincide with those of the head. The straight line of increased density running vertically downward through the inner portion of the outline of the head is cast by the lateral margin of the bicipital groove. The curved line representing the lower border of the cyst-like shadow is cast by the inferior articular margin of the head.

region about the joint. The outer one-third of the clavicle is well seen with its spine. The supraspinous fossa appears much broader, being brought into full

salience, an effect quite different from that obtained when the arm is held in adduction.

Postero-anterior films of the shoulder are usually not indicated since it places the scapula some distance from the film. However, one position was found to be use-



Fig. 6. Effect of position of tube focus on roentgenologic relationships.

(Upper) Tube focus four inches above shoulder joint. The superior articular margin of the head is cast entirely free from the shadow of the acromion. The outer end of the clavicle overlies the acromion with the result that the acromioclavicular joint is not well defined. The clavicle lacks its usual curve.

(Middle) Tube focus directly over the shoulder joint. A small portion of the superior articular margin of the head overlaps the acromion. The clavicle is cast at a somewhat higher level with less overlapping of acromion and clavicle is cast at a somewhat higher level with less overlapping of acromion and clavicle. The coracoid tuberosity is partly brought into salience. The curve of clavicle is largely lost.

(Lower) Tube focus four inches below shoulder joint. While the shoulder joint is not clearly defined due to superimposed shadows of the head

ful, presenting much the same information obtained with the arm in full abduction. This is obtained by rolling the body of the patient in the supine position in an oblique plane with the axilla applied closely to the film surface, the central ray being directed downward through the shoulder at right-angles to the film surface.

EFFECT OF ROTATION ON ROENTGENOLOGIC APPEARANCE OCCURRING DURING FLEXION AND EXTENSION OF THE ARM

The various portions of the scapula undergo very little shift in relationships until attempts at extreme flexion are employed. At moderate forward flexion (45 degrees from the frontal plane of the body), the changes are limited to the appearance of the humerus. These latter changes however, are marked, varying greatly with the degree of rotation. In the position of internal rotation (with 45 degrees of forward flexion) the plane of the epiphyseal line is approximately parallel with the film (Fig. 3). The epiphyseal line, as a result, is not visualized. The articular margins of the head cast a circular shadow which is seen, superimposed upon neck and tuberosities. On the film it appears as a cyst, the articular margins of the head simulating the walls of the cyst. The superior margin of the greater tuberosity lies near the superior articular margin of the head and may even lie above it, depending upon the amount of flexion employed. It should be noted that internal rotation and forward flexion result whenever the forearm is applied to the anterior aspect of the chest and bandaged in the usual manner with a Velpeau or a Sayre bandage.

and outer clavicle upon adjacent structures, the acromioclavicular joint is outlined exceptionally well. The shadows of the acromion and outer clavicle are widely separated. Both the coracoid tuberosity and the curve of the clavicle are best seen on this type of film. A low tube focus favors definition of the outer end of the clavicle, acromioclavicular joint and acromion, while a high tube focus best defines the outline of the shoulder joint. A much lighter exposure is desirable for definition of the acromioclavicular joint than has been employed here. This may be accomplished by decreasing exposure factors or, better, by the use of a wedge filter over this region of the film.

With external rotation (maintaining the 45° forward flexion), the plane of the epiphyseal line becomes perpendicular to the film (Fig. 4). The notch between the head of the greater tuberosity, representing the anatomical neck, is well visualized. The outlines of the greater tuberosity are seen very indistinctly. The lesser tuberosity is thrown over laterally into full salience.

From an analysis of these positions the causes for the production of confusing shadows become apparent. Forward flexion combined with internal rotation throws the face of the head downward toward the film, a position favoring the production of cyst-like shadows at the upper end of the humerus. If partial forward flexion is at all marked (such as results from strapping the forearm across the chest), large round shadows simulating cysts are certain to occur on the film.

Since this is a common position of the arm for many of the common injuries of the arm and shoulder, it behooves the roentgenologist to recognize the manner in which the films have been obtained. If any doubt exists as regards the interpretation of the films, an additional film eliminating extension and internal rotation should be obtained, or, if this is impossible, the opposite or normal side should be taken in a position identical with that of the injured side.

For routine purposes anteroposterior films of the shoulder joint should be taken with the arm held in the true anatomic position or as close to this position as circumstances permit (the palm of the hand being directed anteriorly). If removable bandages or slings are present, the arm should be sufficiently freed to eliminate internal rotation and forward flexion. Abduction of the arm is not apt to produce shadows difficult to interpret. The relations between the axis of the humerus and the scapula will, of course, vary with the degree of abduction, but cyst-like shadows will not appear unless internal rotation and forward flexion are permitted. Since, however, there is a tendency on the part of the

patient to internally rotate the arm as abduction is increased beyond the 90° angle, for routine purposes it would appear desirable to avoid abduction. Forward flexion of the arm is particularly undesirable, external rotation superimposing the shadows of the greater tuberosity upon the shaft, while internal rotation superimposes the shadow upon the head (Fig. 5).

In carrying out roentgenologic examinations to define local portions of the humerus or scapula, the following positions are valuable. For the head, greater tuberosity, and surgical neck of the humerus, external rotation favors throwing each part into salience. Abduction is to be avoided because the shadow of the acromion overlies increasing amounts of the head as abduction occurs. For the lesser tuberosity, forward flexion of the arm (30 to 45 degrees) will aid in throwing the shadow of this portion of the humerus upward so that it can be visualized close to the superior border of the humerus, lying between the head and the greater tuberosity. This portion of the humerus may also be frequently visualized with satisfaction by external rotation of the arm combined with horizontal abduction. This position will throw the lesser tuberosity into salience along the lateral border of the upper humerus. This latter position is similar to the former in that both employ forward flexion of the arm and differ from it in that the latter combines this movement with external rotation. This is a very satisfactory position provided the arm can be placed in it and provided one remembers in making the interpretation that forward flexion of the arm tends to produce cyst-like shadows through the upper humerus. The bicipital groove is usually best visualized by external rotation, the groove being cast along the lateral border of the upper humerus. The deeper portion of the trough of the groove is visualized if horizontal adduction is employed in addition to external rotation.

The articular end of the acromion is seen through its narrowest aspect when films are

obtained in the usual anteroposterior position, but its broader dimensions may be obtained by abducting and externally rotating the arm. The base of the acromion is better visualized without abduction. As the extent of abduction increases the base of the acromion and the scapular spine run in a nearly straight line as a broad band of density. The coracoid process is very poorly visualized in the usual anteroposterior film of the shoulder, but can be brought into salience by abduction and external rotation of the arm. In complete abduction, the tip of the coracoid process often overlies the outer end of the clavicle. At 135 degrees of abduction, the coracoid process is usually visualized above the level of the superior border of the scapula and beneath the clavicle, and is seen with great clarity in this position. If the shoulder is taken at 90 degrees of abduction, external rotation materially aids in throwing the

coracoid process into salience. The glenoid and the neck of the scapula are usually best brought into salience if pain does not prevent the use of the position by extreme abduction, elevating the arm away from the side of the body as much as possible. This also outlines the superior border and the axillary border of the scapula to great advantage, the use of this position permitting the visualization of the axillary border, and the lateral portions of the scapula, including the glenoid, are entirely free of lung structures. The outer end of the clavicle is often poorly visualized in the usual anteroposterior films of the shoulder. The curve is commonly lacking and the clavicle imparts a straight appearance which is entirely erroneous. The normal sweep of the outer end of the clavicle is observed without difficulty if the individual is able to abduct the arm above the head and externally rotate the arm as much as possible.



Fig. 7. Effects of internal rotation, forward flexion, and the two movements combined.

(Left) Extreme internal rotation without forward flexion. The articular convexity is sharply outlined, directed upward and slightly away from the scapula. The plane of the epiphyseal line can be identified. Note the absence of cyst-like shadows.

(Middle) Forward flexion (45°) without internal rotation. The epiphyseal line is lost. While a definite wall cystoid shadow is not identified, there is a tendency for the upper humerus to appear vacuolated.

(Right) Forward flexion (45°) and internal rotation (90°). The margins of upper humerus outline a cyst-like shadow. The inferior border of this shadow is due to lower articular margin of the head, its circular contour being distorted by the superimposed shadows of the outward flaring of the cortex of the greater tuberosity. Internal rotation and forward flexion alone are incapable of producing the typical shadow of a cyst, while the combined movement will produce such a shadow with great regularity.

If abduction of the arm is not possible, much of this same effect can be produced by employing a tube focus about four inches below the shoulder joint. This position visualizes both the outer end of the clavicle and the acromioclavicular joint quite satisfactorily. If one employs a higher tube focus, the clavicle is seen less well, and when the focus becomes above the shoulder joint level the outer end of the clavicle and the acromion process overlies one another. The articular end of the acromion commonly appears as a slender oval cyst. This position should be avoided in all cases in which an acromion or outer end of the clavicle is to be examined. A tube focus four inches medial, with the arm adducted, may be employed to visualize the glenoid and neck region of the scapula when abduction of the arm is impossible.

EFFECT OF SHIFT IN POSITION OF FOCAL SPOT IN RELATION TO SHOULDER JOINT

In shifting the tube focus four inches above the joint (Fig. 6), the articular portion of the head is thrown entirely down below the acromion process so that this region of the humerus is seen with exceptional clarity. This position, however, does not show the outer end of the acromion or the acromioclavicular joint to best advantage. The outer end of the clavicle is observed overlying the acromion process. Shifting the focus of the tube four inches below the level of the shoulder joint produces marked changes in relationships of the humerus, the acromion, and the clavicle. The humerus is observed overlying a portion of the acromion. The acromioclavicular joint and outer portion of the clavicle, including its curve, is seen with great clarity if not over-exposed. When a tube focus four inches medial to the joint is used, the region about the glenoid and the neck of the scapula is seen without the presence of any confusing shadows. This throws a large portion of the scapula away from the rib cage so that its borders are usually visualized without difficulty, particularly the axillary border. Shifting the tube focus four inches lateral to the

shoulder joint does not appear to aid in visualizing any portion of the scapula, humerus, or clavicle.

FACTORS IN THE PRODUCTION OF CYST-LIKE SHADOWS

Position undoubtedly is the greatest single factor contributing to the production of confusing shadows. This study has shown that a composite motion of the arm is usually necessary before the shadows are particularly confusing (Fig. 7). Internal rotation when combined with forward flexion of the arm has been found to produce these shadows with great regularity. Simple internal rotation without forward flexion, for example, is not apt to be particularly confusing, though such films are not desirable for routine radiography. Forward flexion without any internal rotation may seriously handicap the interpreter and is more apt to do so than internal rotation alone. The combination of these two movements is necessary for the production of typical cyst-like shadows. This combined movement throws the head face downward toward the film and one observes the articular margin of the head as a round cyst-like shadow. There are other factors which contribute to the production of these shadows or tend to accentuate them. These are (1) diffuse atrophy of bone and degenerative changes occurring at the articular margins of the upper humerus; (2) atrophy which leads to a washed-out appearance of the bone and tends to impart a translucent appearance to the center of the cyst-like shadow; (3) the presence of new bone formation at the articular margins which accentuates the margins of the cyst-like shadow and tends to give a true wall effect to the cyst. It should be noted that while bone atrophy and degenerative changes at the articular margins of the head accentuate the effect, these factors are impotent unless the head is thrown in a position of internal rotation and forward flexion such as results when the forearm is strapped across the front of the chest.

SUMMARY AND CONCLUSIONS

1. The effect of movement of the shoulder joint upon the changing anatomic relationships has been correlated with the radiographic appearances produced as a result of such movement.

2. For routine radiography of the shoulder, the placing of the arm in the anatomic position with the palm of the hand forward in the supinated position is recommended whenever external rotation can be employed, because this position defines the body structures at the shoulder with great clarity except for the lesser tuberosity of the humerus, and at the same time avoids the possibility of the production of confusing shadows.

3. For the lesser tuberosity and portions of the scapula and outer clavicle, several positions have been described which will greatly enhance the amount of infor-

mation to be gained by radiography if the position proves to be one which can be assumed by the patient.

4. Internal rotation and forward flexion of the arm are to be avoided in radiography of the shoulder. These movements of the arm favor the production of confusing shadows in the upper end of the humerus and offer a further disadvantage in that the head and neck as well as the tuberosity are not clearly defined.

5. A tube focus four inches above the shoulder joint favors better definition of this joint, while one four inches below the shoulder joint enhances the definition at the acromioclavicular level.

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THE GASTRO-INTESTINAL TRACT IN CHILDREN¹

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IN studying the roentgenologic examination of the intestinal tract of adults we are often confronted with various problems which are very difficult to explain. Dr. Cunningham, Dr. Walton, Dr. Hanner, Dr. Waltz, and I studied the

In the investigations of the gastro-intestinal tract it seems desirable that efforts should proceed along the line of adapting the technic more closely to the normal functioning of the alimentary tract. In this way the physiology as well



Fig. 1-A. Stillbirth. No air in lungs or gastro-intestinal tract. (Left.)
Fig. 1-B. Two hours after normal birth. Air is in stomach and small intestines on left side. (Right.)

intestinal tract of infants in an attempt to arrive at a better understanding of the normal and pathologic gastro-intestinal conditions in adults. These infants were studied from the age of ten days to four months. I shall not take your time to give any technical procedure as this has been published, except to state that we studied these children under their normal environments and routine at the Crittendon Home in Denver.

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as the anatomy of these structures can be studied and the beginning of disease can be determined by the early pathologic changes.

An opaque meal may soon be devised which is less artificial and unpalatable than any we are now using. The recent introduction of the meal in a more dilute form so as to demonstrate the rugæ of the stomach and to show more clearly the peristaltic action is a good indication of what may be done. Dr. Pendergrass in his work has shown the effects of different meals and drugs on the reaction of the intestinal emptying time and in the intestinal pattern.

In order to obtain as much knowledge as possible a few x-rays were taken of infants after normal birth and before a single

studies were performed at St. Anthony's Hospital. The procedure revealed the fact, observed by Dr. Wasson and myself,

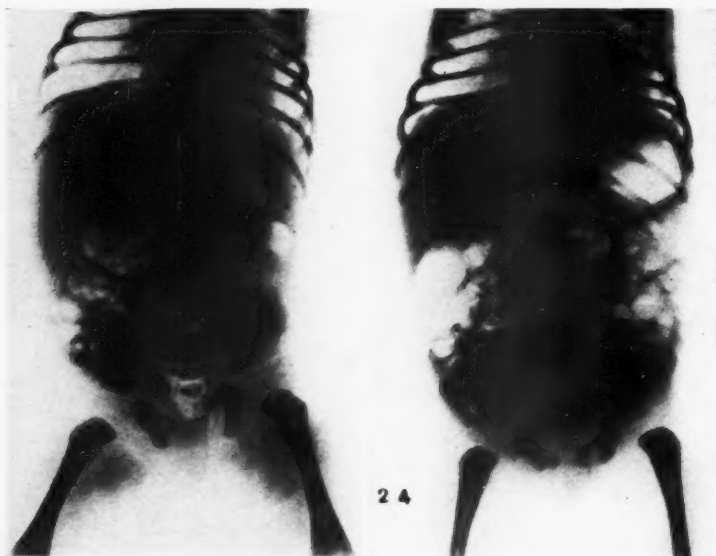


Fig. 1-C. Same child as shown in Figure 1-B, six hours after birth; air is continuing through the intestines. (*Left.*)

Fig. 1-D. Same child as shown in Figure 1-B, twenty-four hours after birth intestinal tract filled with air. (*Right.*)

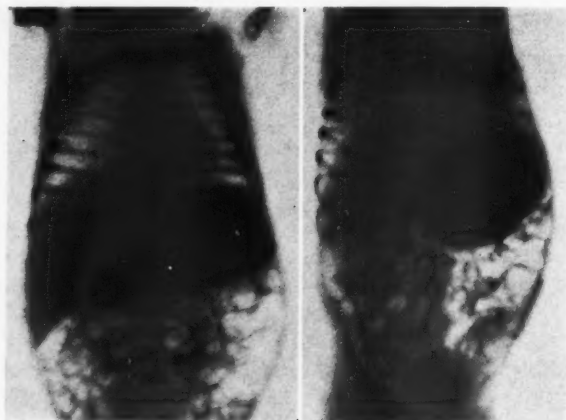


Fig. 2-A. Child aged eleven days. Postero-anterior view; stomach is high and in transverse position, duodenum not showing. (*Left.*)

Fig. 2-B. Ten minutes later; oblique view, showing duodenum. (*Right.*)

breath had been taken; then a second x-ray immediately after the first breath, followed by others at five minutes, ten minutes, and at twenty-four hours. These

that air enters the stomach with the first breath and with subsequent breathing continues on through the intestinal tract. From then until after death, air makes up

a part of the gastro-intestinal contents. This raises the question as to the possibility of air being the first stimulant to

The stomach as it fills with the meal moves outward toward the anterior abdominal wall, slightly downward, and to the

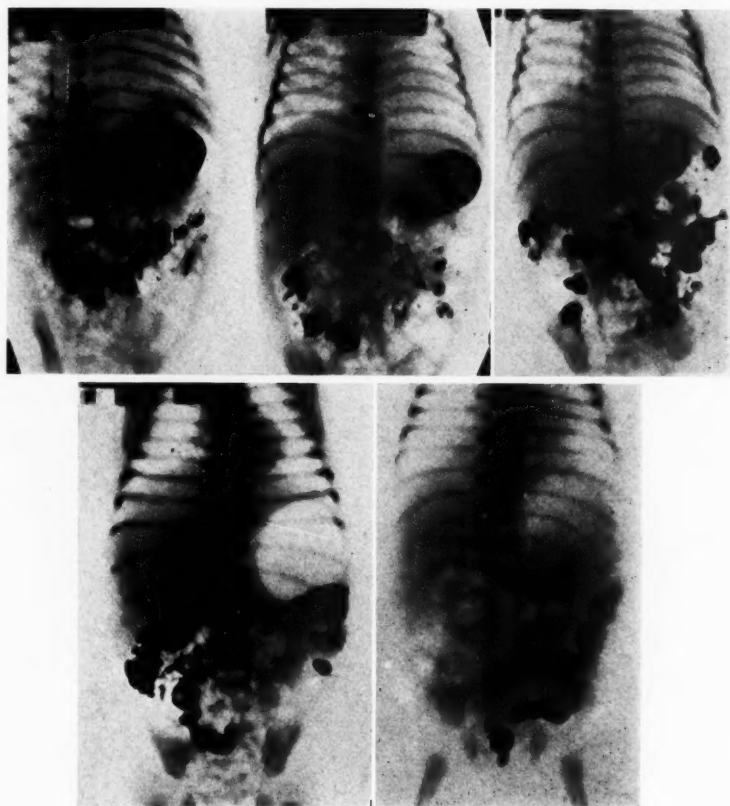


Fig. 2-C. Two-hour film; small intestinal pattern different from adult. (*Upper left, two views.*)
 Fig. 2-D. Four-hour film; meal progressing rapidly through intestines. (*Upper right.*)
 Fig. 2-E. Eight-hour film; meal practically all in colon. (*Lower left.*)
 Fig. 2-F. Twenty-eight-hour film; small residue in lower left colon. (*Lower right.*)

enter the gastro-intestinal tract, and it may be a large factor in starting the first desire to nurse.

The infant stomach assumes a transverse position, is high in the abdomen, and to date, not a single low stomach has been noted in a normal child under nine months of age. The lower border of the greater curvature is usually above the level of the third lumbar vertebra. It takes various shapes, depending upon the age of the infant. The most usual shapes are the following: pear-shape, ovoid, occasionally steer-horn. The shape of the stomach varies in different examinations.

right, completely obscuring the pylorus and duodenum in the postero-anterior view. The meal starts leaving the stomach immediately. There is seldom any evidence of a peristaltic wave in the normal infant stomach under three months of age. Apparently the stomach contracts gradually in its entirety as it seems to shrink in size in all diameters as the contents enter the small intestines. This finding has not been conclusively established and is still being investigated. Only occasionally is a peristaltic wave observed on the roentgenogram.

As the stomach empties it tends to form

a large tube. Often at this stage the pylorus and duodenum are seen stretching to the right on about the same level with

the stomach proper. The pylorus is not clear-cut and is just noted at the end of the stomach. Its position varies, according

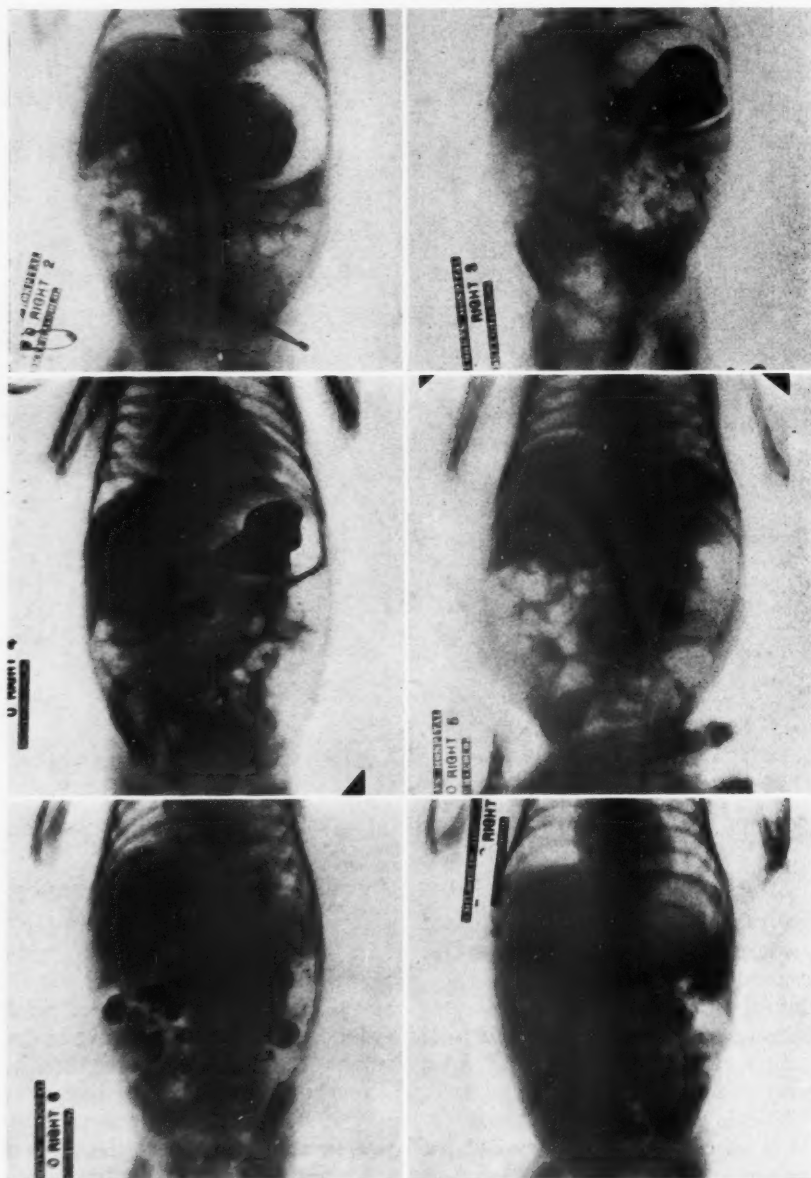


Fig. 3-A. Child aged two months. Postero-anterior view of stomach in transverse position. (Upper left.)

Fig. 3-B. Twenty minutes later; oblique view showing duodenum in horizontal position. (Upper right.)

Fig. 3-C. One-hour film; duodenum appears as tube. (Middle left.)

Fig. 3-D. Three-hour film; stomach contracting in its entirety. (Middle right.)

Fig. 3-E. Six-hour film; stomach empty; no definite intestinal pattern. (Lower left.)

Fig. 3-F. Twenty-four-hour film; very small residue in cecal region. (Lower right.)

to the distention of the stomach, and is very movable in the transverse and antero-posterior direction. It is not higher than

the lesser curvature of the stomach and usually it is lower.

The duodenum is of special interest as

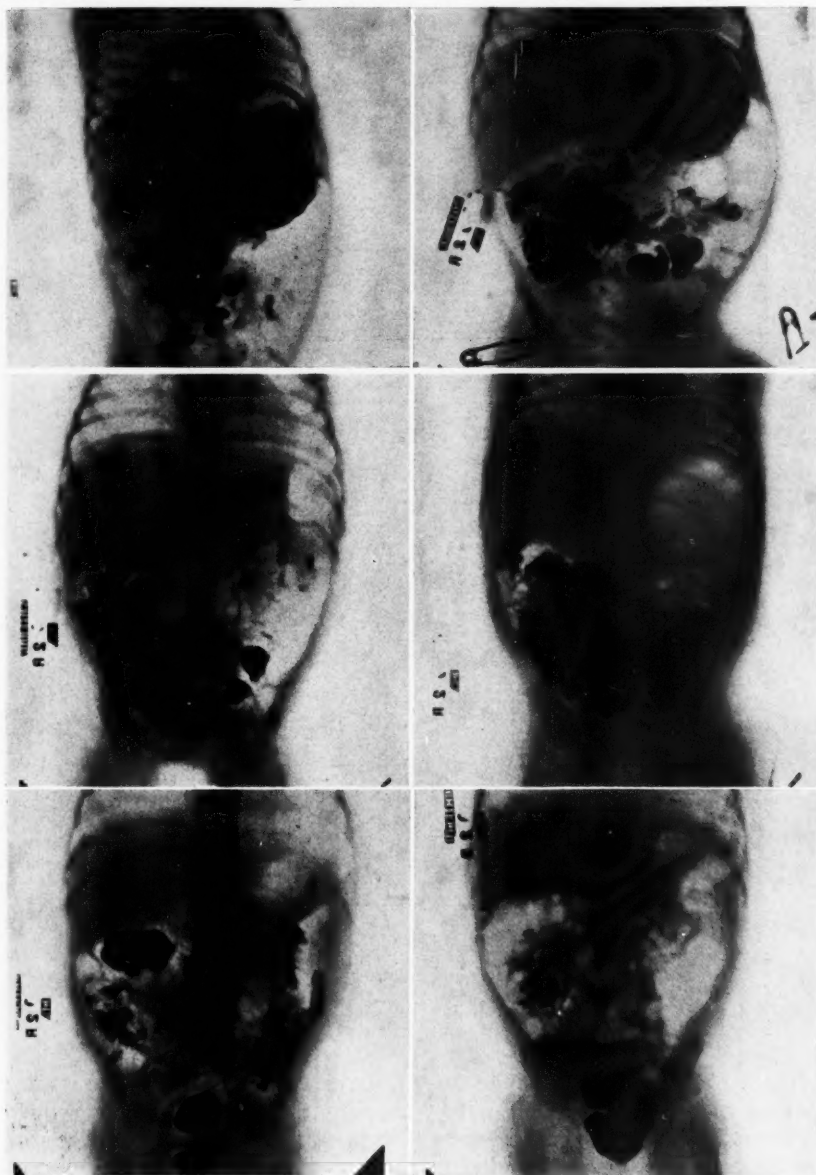


Fig. 4-A. Child aged five months; fifteen minute film; oblique view. Stomach high; duodenum only slightly visualized. (*Upper left.*)

Fig. 4-B. One and one-half-hour film; stomach has changed shape and duodenum visualized on level with lower part of stomach. (*Upper right.*)

Fig. 4-C. Six-hour film; stomach practically empty; intestinal pattern different from adult. (*Middle left.*)

Fig. 4-D. Nine-hour film; stomach empty; meal practically all in colon. (*Middle right.*)

Fig. 4-E. Twelve-hour film; meal all in colon. (*Lower left.*)

Fig. 4-F. Twenty-four-hour film; small amount of meal remaining in rectum. (*Lower right.*)

the first portion is behind the pyloric end of the full stomach and cannot be seen in an x-ray taken from the direct postero-

When the second and third portions are visualized they are practically the same as the first portion.

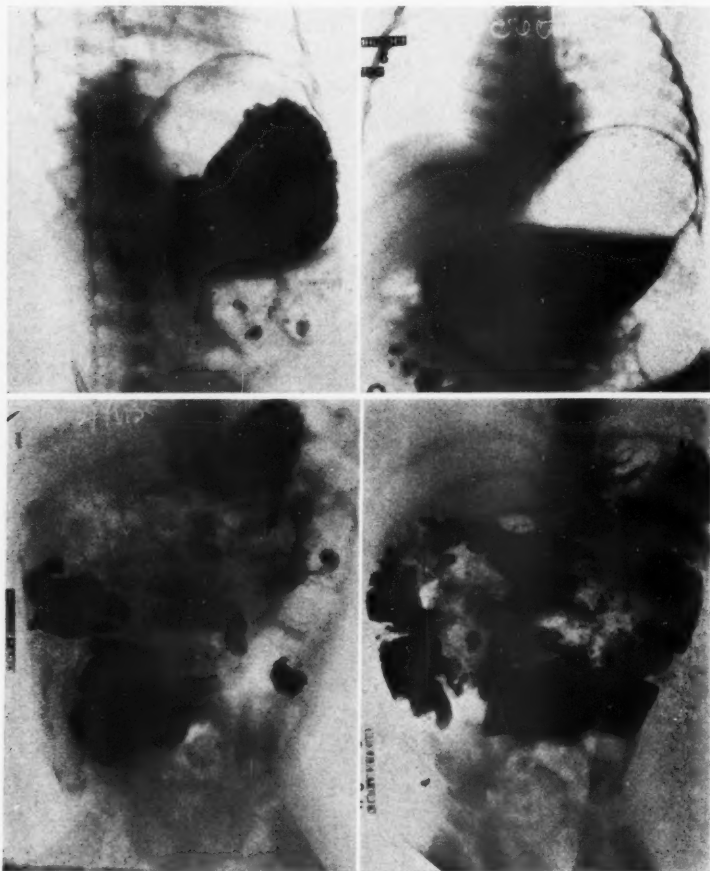


Fig. 5-A. Child aged one year; oblique view. Stomach high in abdomen. (*Upper left.*)

Fig. 5-B. Same child, erect position. Stomach does not swing down as in adult. (*Upper right.*)

Fig. 5-C. Four-hour film; intestinal pattern beginning to change to adult type. (*Lower left.*)

Fig. 5-D. Six-hour film; stomach practically empty; meal filling colon to splenic flexure; colon was empty in twenty-four hours. (*Lower right.*)

anterior view. The infant must be rotated well to the right—to about a 60° angle. The usual triangular cap is rarely seen; the first portion of the duodenum fills in a horizontal position as a more or less short straight tube and, as a rule, in the first few months, lies at the level of the first lumbar vertebra. The second and third portions are seldom visualized, apparently due to the rapid emptying time.

In the jejunum and ileum the meal is apparently segmented and grouped. The segments usually have oblong shape with not much form. These segments are found grouped in various sections of the abdomen as the meal progresses. The usual feathery appearance (sometimes spoken of as "snow flake appearance") of the jejunum, seen in the adult, is not observed in infants.

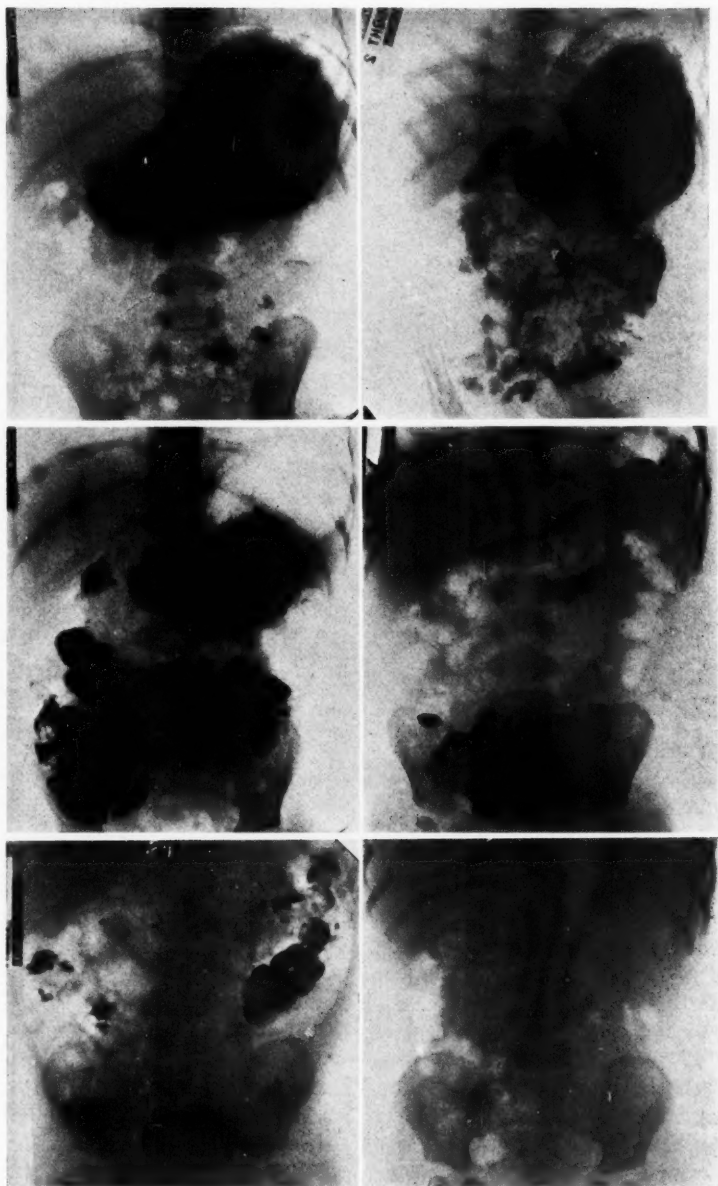


Fig. 6-A. Child aged nineteen months. Stomach high in abdomen. (*Upper left.*)

Fig. 6-B. Fifteen-minute film; oblique view showing duodenum and stomach changing to adult type. (*Upper right.*)

Fig. 6-C. One-hour film; intestinal pattern beginning to change to adult type. (*Middle left.*)

Fig. 6-D. Four-hour film; intestinal pattern in ileum changing to adult type. (*Middle right.*)

Fig. 6-E. Twenty-four-hour film; showing more stasis of colon than in young infant. (*Lower left.*)

Fig. 6-F. Forty-eight-hour film; colon completely empty. (*Lower right.*)

When the meal reaches the cecum there is not the delay which is quite customary in the adult. It moves rapidly on toward the rectum. The position of the colon is not unlike that in the adult except that the

owe our first roentgen observation of the intestinal motions in animal and man.

The structure of the intestinal tract in infancy and childhood is different from that of the adult. Many observers have



Fig. 7-A. Child aged six weeks; appendix showing cecum empty. (Left.)

Fig. 7-B. Same child, checking to show cecum filled; appendix is retrocecal. (Right.)

transverse colon is not low and assumes a fairly straight line across the abdomen, usually crossing at the level of the first or second lumbar vertebra, but this depends on the state of dilatation of the stomach by gas. The hepatic and splenic flexures are as a rule gradual curves, but they seem well fixed. The peristaltic waves apparently move the contents with ease and although the meal is often cut into widely separated segments, the haustra are not acute or pronounced. As a rule the barium meal has entirely left the gastrointestinal tract in twenty-four hours. Occasionally a few areas of opaque residue are left in the sigmoid and rectum.

The roentgen examination permits study of the motor function of the intestines and the progressive action of their contents under physiologic conditions in a continuous manner. It is to Cannon that we

noticed the thin, paper-like consistency of the intestinal wall. Examined, it reveals the following:

(a) The mucous folds and the valvulae conniventes are more abundant in childhood, but their lengths and heights are distinctly smaller than in the adult.

(b) The mucous membrane is absolutely and relatively more developed than the muscular layer; it is very delicate and vascular, and more cellular as compared with the adult.

(c) The submucous tissue is less in quantity and more delicate in character. The elastic fibers are feebly developed—a fact which explains the greater vulnerability of the infant's intestines as compared with those of the adult. The muscularis shows a thickness equal to both the mucosa and submucosa.

(d) The size of the villi and follicles is

smaller in children than in the adult.

The variations in the anatomy mentioned in regard to mucosa, submucosa, and muscularis probably account for the statement made earlier in this paper, to the effect that the meal is segmented and grouped in the jejunum and ileum in the infants studied.

The small intestine bears the principal work of digestion and absorption of food. The digestion of the food is accomplished by two main types of intestinal motility: the peristaltic and pendulum motions. The peristaltic motions serve to propel the injected food onward through the intestinal canal, while the pendulum motion serves to mix the food with the intestinal juices. The pendulum motion originates by co-ordination of the annular and longitudinal musculature by which the contraction of the longitudinal musculature of the intestine is shortened and broadened, and the contraction of the annular musculature is constricted. Thus these motions cause the food to be digested and continually permit the food to come in contact with new surfaces of the small intestinal mucosa for absorption.

The exceedingly lively peristalsis of the small intestine is significant for the duration of the intestinal passage in the young infant. The meal is often at the cecum in one and one-half hours and the small intestine is empty in five hours unless the stomach is slow in emptying, while in the adult the time is usually about three hours to reach the cecum and from eight to ten hours to empty.

The digestive activity of the large intestine plays only a subordinate rôle in comparison with that of the small intestine. It is here that we see many of our problems in the adult. The stagnation and exclusion of the ingested food and the resorption of the water thus causes a thickening of the intestinal contents.

The waves of the large intestine correspond essentially to those of the small intestines. Here also are found the peristaltic and pendulum motions, which have the same function as in the small intes-

tines. Von Bergmann and Katsch showed that the haustra are not anatomic preformation structures, but in the changeable play of motion, they exercise the functions of mixing, kneading, and pendulum action, which in the polymorphic haustration find a multiform expression in the roentgenogram. The haustra are said to be absent in the newborn, but they appear in the first months of post-natal life. This is not true, as they are present in our series on our first examinations, namely, in babies of from ten to fourteen days old. They are not as pronounced as in the adult, but one would not expect to find them so, due to the difference in the development of the mucosa, submucosa, and muscularis, as described above.

The cecum in the infant is in approximately the same topographical relation as in the adult. I have already mentioned the position of the transverse and descending colon. I wish to repeat that as a rule the colon is empty in these babies in twenty-four hours, which is not the case in the adult. If there is any residue in the colon at twenty-four hours, it is usually only in the sigmoid and rectum. Therefore, it is possible that the constipation seen in adults may be the result of the stagnation of the lower part of the colon, beginning in infancy. Infants have an average of two stools per day, while in adults the average is only one. That one stool does not empty the colon is proved by the barium meal remaining in the colon usually for thirty-six hours or longer, depending upon the amount of constipation.

If one studies the adults who have two evacuations per day he finds that they do not have the toxic conditions seen in patients with constipation. In comparison, babies require more nourishment than adults, but they do not have the stagnation of the colon. Thus it follows that absorption from the intestines must take place more energetically in early childhood than in the adult life.

In discussing the gastro-intestinal x-rays of infants and young children, their exact age must always be taken into account, as

apparently the position of the organs and their functions are undergoing continuous change. There is apparently a progression of form and function which takes place from birth until death.

In conclusion, I wish to state that the gastro-intestinal tract of infants presents many different aspects from that of the adult. I have not attempted to form any definite conclusions, as many problems requiring further study have presented themselves and are at present unsolved. I find it is necessary to establish more definite standards of the physiology of the gastro-intestinal tract in the first few weeks of life.

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A METHOD FOR DECREASING THE IONIZATION IN THE SKIN APPLICABLE TO SUPERVOLTAGE X-RAY THERAPY

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IN the "Béclère Festschrift für Strahlentherapie" (1) one of us pointed out a new possibility in radiation therapy with supervoltage x-rays. In the present paper will be given some corroborating experimental data obtained with gamma rays, in the absence of x-rays produced at potentials above one million volts.

So far as we are aware at present, all biological and therapeutic effects brought about by x-rays and gamma rays from radium are the result of ionization taking place in the tissues of the test object or in those of the patient. In the treatment of patients part of this ionization is desirable and part harmful; *i.e.*, the ionization occurring in the tumor destroys the cells of the tumor and tends to bring about the result sought after, whereas that occurring in the skin or the normal tissues between the skin and the tumor results in unfavorable reactions such as erythema, epithelitis, ulceration, etc. The limiting factor in the amount of ionization with consequent cell destruction which can be brought about in the tumor is the amount of concurrent damage which can be safely tolerated by the skin and normal tissues between the skin and tumor. If it were possible to reduce materially this ionization without lowering the dose received by the tumor, either one of two results of practical importance might be brought about: the treatment of tumors by external irradiation in dosages now found to be therapeutically effective without the severe reactions seen in the skin; or an increase in tumor dose without increasing damage to the skin.

Electromagnetic radiation of therapeutic wave lengths such as occur in beams from x-rays tubes and radium probably bring about reactions through the formation of secondary electrons, high speed negatively charged particles, which in turn separate

electrons from atoms in the material irradiated. It is this ionization brought about by secondary electrons in air which allows us to measure the intensity of x-ray and gamma-ray beams. In radiation therapy part of the ionization occurring in the superficial layers of the skin is the result of secondary electrons produced in the air and any other intervening matter between the radiant source and the skin. The rest is due to electrons liberated in the skin itself.

Not all of such electrons have the same speed or length, of course. The speed of the electron and hence the distance it will go either in air or through the skin depends on the amount of energy imparted to it. For instance, the farthest distance a secondary photo-electron generated by 200 kv. x-rays can go in air at standard conditions of temperature and pressure is about 32 cm., whereas the corresponding distance at 1,000 kv. is in the vicinity of ten times this distance, or 340 cm. (1). This does not mean that all secondary electrons will go such a distance but only an occasional photo-electron, one having the maximum amount of energy. However, it does make it evident that beta particles from different x-ray sources will be capable of different degrees of penetration through the skin, the maximum depth of penetration depending on the generating voltage. Skin is roughly eight hundred times as dense as air, so that, allowing for the difference in density, the *most* penetrating electrons from a 200 kv. source could go only 0.4 mm. into the skin. Remembering that this distance can be reached only by the very rare photo-electron, generated in the air just above the skin, whose course is straight downward and that the vast majority of secondary electrons have much shorter paths, it becomes apparent that the ionization produced by the secondary electrons generated

in the air or matter between an ordinary x-ray tube and the patient's skin is confined to the very superficial layers of the skin. The effective secondary electrons, of course, are the ones generated in the skin and subcutaneous tissues themselves.

If we consider the beam from a 1,000 kv. x-ray generator however, the picture is quite a different one. The farthest course of a photo-electron in air at such a voltage has been given above as 340 cm. It is then theoretically possible for such an electron to penetrate somewhere in the neighborhood of 4.2 mm. of skin or tissue, a depth which is much below the horny dead layers and even well below the dermis itself over most areas of the body. This, again, is a maximum distance, but nevertheless the average penetration of the secondary electrons produced by 1,000 kv. x-rays is correspondingly high.

Secondary electrons have two properties which make them fairly easy to remove from a beam of radiation: first, they are negatively charged particles in motion, and in consequence, will be deflected in a magnetic field, and, secondly, they do not travel in straight lines in air but have irregular zigzag courses as a result of atomic collisions. This irregularity of path makes it possible to remove them by sending the beam of radiation through a series of diaphragms or a long narrow channel. A simple experiment brings out this point very strikingly. In Figure 1 is a thin-walled glass tube containing radon, which serves as a source of high speed beta rays (and, unavoidably, gamma rays). At a distance of 62 cm. from the source is placed an ionization chamber made of thin paper with a "front wall" of silk netting. Under these conditions the ionization current produced in the chamber may be taken to be 100 units for purposes of comparison. The same beta-ray source placed in a lead cone as shown in the upper part of the figure, with the ionization chamber properly aligned and again at a distance of 62 cm., produces a current of only 4.8 units. The marked decrease in the ionization current shows that most beta particles which originally reached

the chamber, either have been entrapped by the lead canal or have wandered out of the narrow cone subtended by the chamber. Of course, if beta rays travelled in straight lines originating at the source, there could have been no such decrease in current, since, as shown in the figure, the ionization chamber is well within the geometric projection of the lead cone. The "removal" of the beta rays from the straight line beam reaching the chamber is even more effective than indicated by the above figures, because of the presence of the gamma rays. After placing a strong electromagnet at the mouth of the lead cone to deflect the emergent beta rays, the residual ionization reading due to the gamma rays is found to be 2.07 units. Making allowance for this we find that the ionization in the chamber due to the primary beta rays alone, drops to 2.8 per cent when the source is placed in the lead cone. Although this is an extreme case, it indicates, nevertheless, the great efficacy of the simple canalization method in removing secondary electrons from a narrow beam of extremely hard x-rays, especially when one considers that most of the secondary electrons in such a case would come from the filter, irrespective of the material of which it is made.

If we remove the secondary electrons from a beam of x-rays or gamma rays and direct the beam at the skin, the resulting effect will depend on two factors: first, the depth at which erythema, epithelitis, or ulceration takes place, and, second, how much of a reduction in ionization can be obtained at that depth by removal of the secondary electrons in the air above the skin. Is it possible to remove a sufficiently large proportion of high speed beta particles from any therapeutic gamma or x-ray beam so that a significant difference in ionization will occur in the skin at the depth at which erythema takes place? As already mentioned, such a reduction in ionization may be expected to be of practical importance only in beams the generating voltages of which are of the order of one million volts.

Erythema is an effect taking place in the

skin and not in the subcutaneous tissues. As partial evidence for this may be mentioned the sharpness of the edge of the erythema from a well defined beam of 200 kv. x-rays, a sharpness which would not be ex-

of the body two millimeters or less. The changes causing erythema probably occur more superficially than this.

The erythema caused by irradiation with radium and x-rays is similar in so many re-

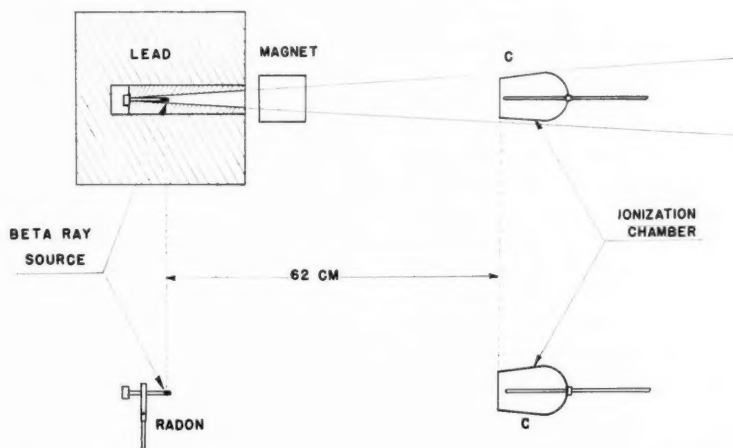


Fig. 1. Effect of canalization of beta rays on ionization at a distance from source.

pected if the erythema were due to changes in the deep arteries or arterioles. The erythema is uniform, a result one would expect only with uniform capillary dilatation and not from arteriolar change. Czunft and Gaal (3) have studied biopsy specimens from skin showing acute radiation erythema and found the most marked changes to be a thinning of the epithelium, a destruction of the cells of the stratum spinosum, and a hypertrophy of the papillae of the cutis. Assuming that the changes causing erythema do occur in the skin, the depth at which they take place is immediately limited to its thickness. Laurens (4) gives as the thickness of the epidermis over the papillae on the forehead 0.06-0.09 mm., on the cheek 0.06-0.1 mm., and on the neck, arm, abdomen, back, and leg 0.04-0.15 mm. Between the papillae it is slightly thicker. The dermis is 1.7-2.4 mm. thick. Assuming that the erythema takes place as a result of damage to the deepest layers of the dermis or corium, this layer would not be more than three millimeters below the surface and in most parts

spects to that caused by ultra-violet light that it may be justifiable to reason by analogy from observations made on the latter. Hasselbach (5), in 1911, using the Kromayer water-cooled quartz mercury vapor lamp, determined spectrographically the transmission of certain wave lengths by human skin. He found no transmission through 1 mm. of skin of wave lengths at or below 3,020 Å.U. and only 0.006 per cent at 3,130 Å.U. These wave lengths are the ones in sunlight responsible for sunburn: 0.1 mm. of skin transmitted 30 per cent at 3,130 Å.U., 8 per cent at 3,020 Å.U., 2 per cent at 2,970 Å.U., and 0.01 per cent at 2,890 Å.U.

These results were questioned by Macht and Anderson (5), who found transmission of ultra-violet light of wave length 2,800 Å.U. through the living abdominal skin of rabbits 1 to 2 mm. thick. Rays of 3,000 Å.U. were transmitted through the whole thickness of the abdominal wall of rabbits, 3 to 4 mm. They thought that Hasselbach's results came from using dead skin which was more opaque than living skin.

Bachem and Reed (7) have done extensive experiments on this problem and fail to confirm Macht and Anderson. They investigated both living and dead skin from dogs and rabbits, finding no change in opacity so long as it was kept stretched and moistened with Ringer's solution. Drying increased rather than decreased the transparency to ultra-violet.

Bachem (8) has carefully studied the transmission of ultra-violet light by the various layers of the human skin using frozen sections of fresh tissue. His results, as summarized in a table, show an absorption of from 66 to 85 per cent of the ultra-violet rays occurring in sunlight and known to be responsible for erythema in the stratum, the thickness of which he gives as 0.03 mm. The stratum granulosum and germinativum at a depth of 0.05 mm. absorbs from 6 to 18 per cent of these wave lengths, while the remaining 9 to 16 per cent is completely absorbed in the corium at a depth of 2 mm. or less. He believes erythema to occur in the stratum germinativum or upper layers of the corium.

The tanning following ultra-violet erythema occurs in the germinativum and granulosum at a depth of from 0.04 mm. to 0.2 mm. Lewis (9) believes the erythema following radiation of any wave length which produces it, ultra-violet or gamma ray, to be due to the liberation of a histamine-like substance in the deeper layers of the epithelium or the superficial layers of the corium which slowly diffuses into the capillaries, causing their dilatation. This view has been further elaborated and the histamine-like substances isolated by Ellinger (10). Ellinger in his monograph on the biological foundations of radiation therapy mentions that by means of the Schulze-Winkler oxidase reaction the depth of penetration of ultra-violet light can be determined. The light destroys the oxidase in the cells upon which it falls, leaving them colorless to a depth of 0.63 mm.

Thus the answer to the question at what depth does the erythema reaction occur in the case of gamma rays is that presumably it occurs within, at most, 2.5 mm. of the

skin surface and probably within 1 mm. If this is so, any method whereby we can reduce the ionization occurring within 2 mm. of the surface ought to reduce the erythema produced or allow a larger dose to be given without further skin damage. Assuming that the ionization can be reduced in these superficial layers and that erythema will not occur with the doses now used therapeutically, no more damage will occur in the subcutaneous tissue than we see at present. But with higher dosages the limiting factor may become the tolerance of the subcutaneous tissues. No experimental work has been done on this question and a discussion of such effects would be in the realm of pure speculation. Nevertheless, one should bear this in mind.

The answer to the second question, "How much can we reduce the ionization at these depths by removing secondary electrons from the incident beam?" is the subject of our present experiments. In order to obtain a beam containing very high speed secondary electrons, we have used radium or radon as our source. In practical therapy the method would be more applicable to supervoltage x-rays than to gamma rays, because of the mechanical difficulties in working at such short distances as are necessary with the usual amounts of radium in packs or bombs.

As was stated above, it should be possible to remove many secondary electrons from a beam simply by canalizing it. Such experiments were carried out under rather unfavorable conditions with the four-gram radium element pack. The method was to measure the ionization produced by the radiation as different methods of controlling the electrons were investigated. The construction of the ionization chamber, of the parallel plate type, is indicated in Figure 2. The upper (charged) electrode is made of fine silk netting, so that electrons can pass freely through its interstices and ionize the air between it and the lower electrode. The latter is a drum skin (parchment) stretched tightly and fastened to a block of paraffin, as shown. The desired electrical conductivity of both electrodes

was obtained by painting with India ink. The collecting electrode is a circle 3 cm. in diameter separated from the rest of the skin by an air space of 2 mm., and connected to the current measuring instrument by a

beyond the mouth of the pack. One of them had a converging, and one a cylindrical channel, shown to scale in the figure. Other types were also tested; the data for these two are, however, typical.

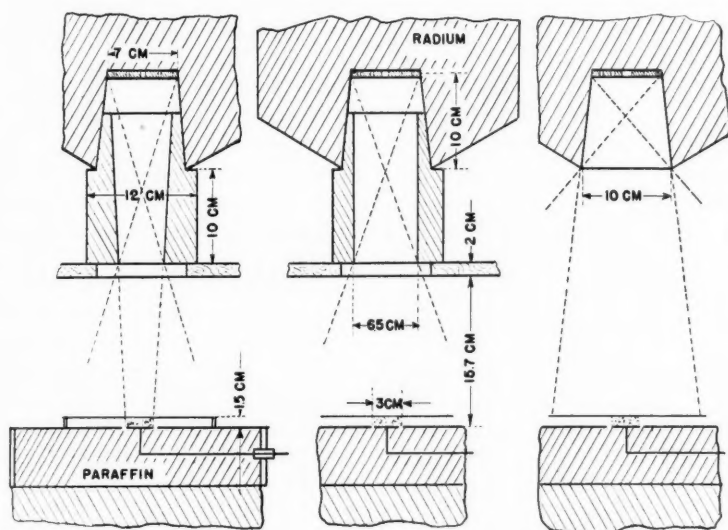


Fig. 2. Experimental conditions with canalized gamma rays.

fine aluminum wire embedded in the paraffin backing. The skin surrounding the collecting electrode serves as a guard ring and is connected to ground.

When a beam of gamma rays falls upon the chamber, as shown in the diagram, ionization occurs which is comparable to that at the surface of the human body. It is produced by the secondary electrons coming from the filters in front of the radium, from the walls of the collimator, from the air, and also from the underlying parchment attached to the paraffin block. This last group are a part of the back-scatter, and correspond to that which the surface of the skin receives from underlying tissues.

In Figure 2 are shown three schematic diagrams of the four-gram radium pack(11) as used in the experiments. In two of them lead collimators have been fitted to the mouth of the aperture. They were 12 cm. in outside diameter and projected 10 cm.

A direct comparison of the ionization readings with and without the lead collimators in place is not permissible, since the latter change the size of the gamma-ray beam. However, the effect of the canalization on the electron content of the beam may be ascertained in another way. If a thin sheet of cellophane be placed on top of the upper electrode it will absorb some of the slow electrons from the beam, but will itself contribute some, which will enter the chamber. If it contributes more than it removes, the reading with it will be greater than the one without it. Successive layers may be added until one produces no further increase, that is, until the electrons added just compensate for those absorbed. Further layers of material will only decrease the reading. In a beam from which many electrons have been removed, it will be necessary to interpose an appreciable thickness of organic material before the

maximum reading is obtained, that is, before there are as many secondary electrons as there would have been in the original gamma-ray beam, in equilibrium with its secondary electrons.

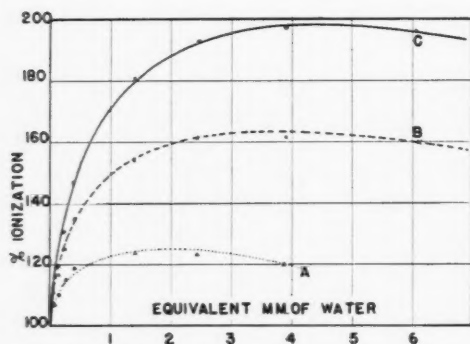


Fig. 3. Increase of ionization with increase in thickness of material traversed by canalized gamma rays.

Curves A and B of Figure 3 were obtained in this way by using, respectively, the cylinder and cone of Figure 2. In either case the ionization with no material directly over the chamber is taken as 100 per cent and the relative increase with the addition of successive layers of cellophane or celluloid (reduced to equivalent thicknesses of water) is given by the ordinates. It is interesting to note that in the case of the cylindrical collimator the maximum increase found amounts to 25 per cent and occurs with a water equivalent thickness of 2 mm., whereas in the case of the conical collimator the corresponding figures are 63 per cent and 3.4 mm. It would seem from this that the smaller channel is much more effective in removing secondary electrons from the gamma-ray beam. The situation, however, is complicated by another factor.

Considering the geometric relation between the radiating surface and the lead collimators, it is evident that the gamma rays which strike the inner surface of the collimators must produce large numbers of secondary electrons, many of which may reach the ionization chamber. For this reason tests were made with a secondary

filter of bakelite 1.6 mm. thick at the end of the cylindrical collimator. The curve obtained under these conditions is labeled C in Figure 3. The great difference between curves A and C, obtained under identical conditions, *except for the bakelite secondary filter*, brings out clearly the very large excess of secondary electrons produced in the collimator wall. This is due to two causes: (1) the high atomic number of the material of the collimator (lead), and (2) the proximity of the lead to both the source and the ionization chamber. The bakelite filter contributed secondary electrons which reached the ionization chamber, but the number of secondary electrons which it absorbed was much greater. Thus, the lead collimator in this case served no other purpose than to provide a narrow beam of gamma rays, which was not even well delimited on account of the penumbra, due principally to the large size of the radiating surface (which we could not change). Accordingly, the removal of a large proportion of the secondary electrons present at the emergence side of the bakelite filter, was due solely to the scattering process whereby many electrons wandered out of the gamma-ray beam in its passage through only 15 cm. of air. This is a point of considerable practical importance, because it shows that much can be accomplished in decreasing the number of secondary electrons in a narrow beam of gamma rays by the simple expedient of placing the secondary filter at some distance from the skin. In this connection it might be mentioned that in our pack, as ordinarily used for therapeutic purposes, the placing of the secondary filter at the bottom of the cavity in the lead enclosure through which the radiation passes does not suffice, even though the cavity is lined with brass 1.6 mm. thick. The proper thing to do is to place the secondary filter at the mouth of the port which, in turn, should be at a considerable distance from the skin during a treatment. The size of the beam of gamma rays is obviously important and should be as small as possible, consistent with therapeutic requirements. It is also desirable to keep the penumbra as small as

possible. This calls for the use of one or more sources of radiation of small dimensions mounted in properly designed collimators. These conditions cannot be fulfilled satisfactorily unless the radium-to-skin distance is about 20 cm., which, of course, is not practicable unless much larger amounts of radium are available than those used in bombs at present.¹

The limitations of intensity of radiation and (to a certain extent) size of the radiating source, are not present in the case of supervoltage x-rays. Therefore, suitable provisions may be made to eliminate most of the secondary electrons from the radiation beam before it reaches the skin. The most effective set-up will have to be determined experimentally for any given supervoltage installation.

Referring back to Figure 3 and particularly to curve C, it will be seen that the maximum ionization is obtained with an equivalent water thickness of from 4 to 5 mm. This means that if a patient were to be irradiated under the conditions of the experiment, the maximum ionization would be produced at a tissue depth of about 4 mm. The intervening tissue layers would be ionized to a smaller extent. This is particularly true of the first half-millimeter layer, within which the most radiosensitive cells of the skin are probably located. Accordingly one might reasonably expect a milder skin reaction under these conditions. This point cannot be tested experimentally at this time since the amount of radium in the pack (4 grams) is too small to permit the administration of an erythema dose at a long radium-skin distance in a reasonable length of time.

Since it is important to get some idea of the expected lower biologic effectiveness of gamma rays from which the secondary electrons have been removed wholly or in part, some experiments were carried out using the eggs of the fruit fly *Drosophila mela-*

nogaster as test objects. The small size of the eggs is an important factor since the contribution of secondary electrons by the egg itself is not large. The higher radiosensitivity of this material as compared to

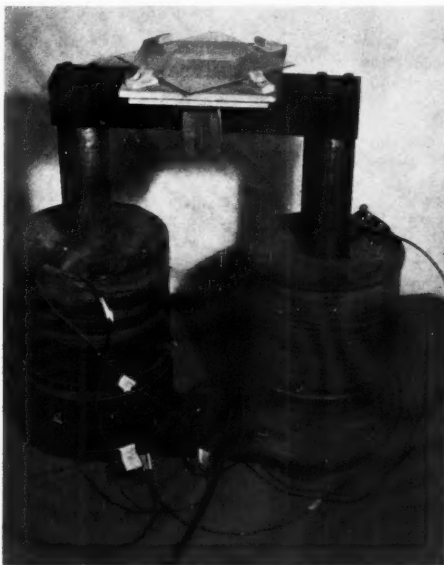


Fig. 4. Arrangement for exposing *Drosophila* eggs to gamma rays.

human skin is advantageous; nevertheless, it is not possible to obtain the desired biologic effect by irradiating *Drosophila* eggs at long distances with our radium pack. For this reason the apparatus shown in Figures 4 and 5 was used in the experiments, relying on a magnetic field to deflect the secondary electrons out of the beam. A lead block with a rectangular slot cut through it was supported between the poles of a strong electromagnet. The source of the gamma-ray beam was a number of radon tubes (marked "Ra Source" in Figure 5) in a lead and brass holder which fitted in the slot and permitted adjustment of the radon-to-eggs distance. The radon tubes were enclosed in gold-platinum capsules of 0.5 mm. wall thickness, and a small block of bakelite 6 mm. thick, placed above the capsules, served as the usual secondary filter. The magnetic field across the slot directly

¹ There is a possibility which should be explored, that by an appropriate combination of collimators, powerful permanent magnets of the new type, and diaphragms, a radium-skin distance somewhat less than 20 cm. would be sufficient.

over the radon tubes was increased by inserting at this level soft iron plugs between the pole pieces and the edges of the slot. The direction of the magnetic field was parallel to the axis of the radon tubes and there-

modifications. They were irradiated for varying intervals, incubated at $26^{\circ}\text{C}.$, and counted on the second day following irradiation. Approximately 1,000 mc. of radon was used. With the magnet off, an ex-

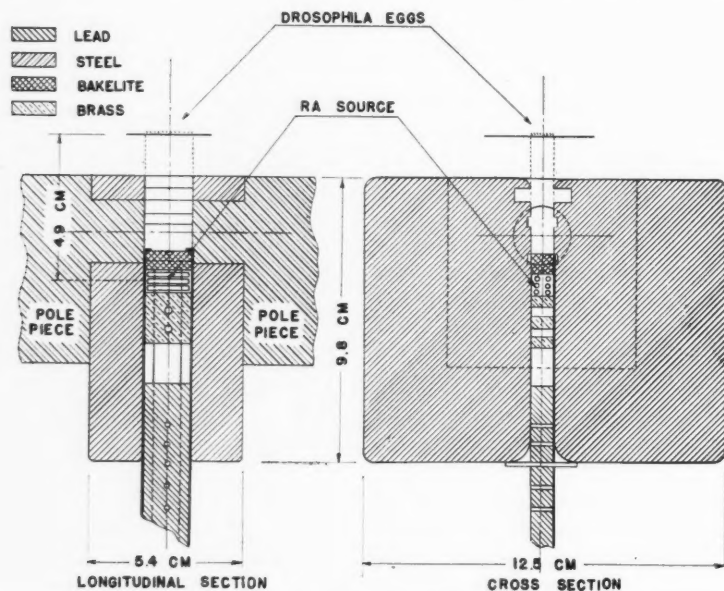


Fig. 5. Detail of apparatus shown in Figure 4.

fore in the direction of the larger dimension of the rectangular cross-section of the gamma-ray beam. Thus the electrons were deflected sidewise toward one of the wider sides of the slot. Ridges were provided to act as "traps" for these electrons. The eggs were suspended on the under side of a piece of thin fabric (chiffon) 4.9 cm. above the radon. By referring to the cross-section in Figure 5, it will be seen that gamma rays and secondary electrons liberated in the sides of the lead slot as well as in the bakelite block, will reach the eggs. When the magnet is turned on, the beta particles are deflected to one side or the other, depending on the direction of the field, and a great many are either caught in the lead sides with the slots or pass to one side of the eggs.

For the experiments, eggs were obtained according to the method originally described by Packard (12), with some slight

posure of 27,000 millicurie-minutes was required to kill 50 per cent of the eggs. With the magnet on, other conditions remaining the same, the corresponding exposure was found to be 50,000 millicurie-minutes. The complete results of this experiment are shown graphically in Figure 6. It is evident that in this case the magnetic field removed enough secondary electrons to practically halve the lethal effect of the beam of radiation. It should be noted in this connection that even if all the secondary electrons were prevented from reaching the eggs, the gamma rays would still affect them, through the secondary electrons liberated within the eggs themselves. Whether the lethal effect observed, in the tests with the magnet on, may be accounted for solely on this basis, or was partly due to secondary electrons which reached the eggs in spite of the magnetic field, is diffi-

cult to say. On account of the necessity of exposing the eggs at relatively short distances from the source, the conditions for the complete elimination of secondary electrons were not ideal.

hatching point, with the magnet on, is from 32,000 to 48,500 millicurie-minutes in the curves of Figure 7. That is, the exposure had to be increased 50 per cent to produce the same effect on the eggs when the mag-

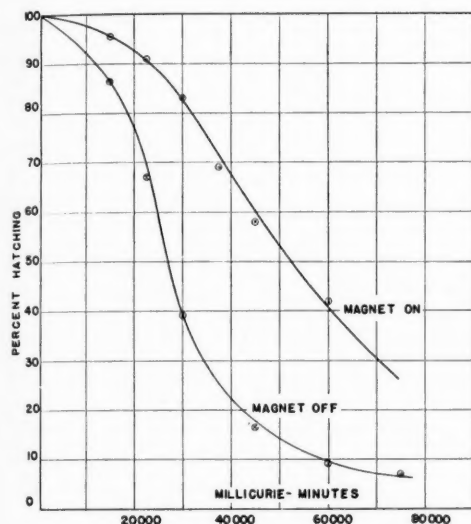


Fig. 6. Survival curves of *Drosophila* eggs exposed to gamma rays in air, with and without magnetic field.

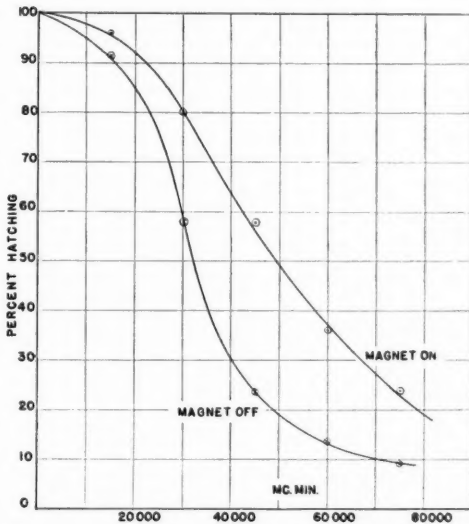


Fig. 7. Survival curves of *Drosophila* eggs exposed to gamma rays through 1.03 mm. celluloid, with and without magnetic field.

In order to determine the lethal action of the radiation after traversing some matter and thus acquiring more secondary electrons, eggs were exposed on top of celluloid sheets which intercepted the vertical beam of radiation. Exposures were made with and without the magnetic field for different thicknesses of celluloid. The results are shown in Figures 7 and 8. It will be seen from Figure 7 that the 1.03 mm. sheet of celluloid used in the experiment was not sufficient to provide the full quota of secondary electrons removed by the magnetic field. In fact, there is still a marked difference in the lethal action of the gamma-ray beam with and without the magnetic field. From this, one may deduce that a considerable proportion of the secondary electrons in the gamma-ray beam passed through the 1.03 mm. sheet of celluloid when the magnet was not turned on. The increase in exposure at the 50 per cent

netic field was present. With sheets of celluloid 2.78 and 3.78 mm. thick, directly under the eggs in the path of the radiation, no significant differences were found with the magnet on and off (Fig. 8).

In these experiments particular attention was paid to the exposure of eggs with and without the magnetic field under as nearly the same physical and biologic conditions as possible. On the other hand, it was not found practical to maintain the same biologic conditions for the eggs from one set of experiments to another. Thus the radiosensitivity of the eggs was not the same in the three sets of experiments shown in Figures 6, 7, and 8, as indicated by the fact that the three curves obtained without the magnetic field are somewhat different. The relative values in each set, however, do not suffer from this limitation. They are given in Figure 9 in terms of the percentage increase in millicurie-minutes necessitated

by the presence of the magnetic field, for different thicknesses of celluloid in the path of the rays, reduced to equivalent thicknesses of water.

The results of the biologic experiments are qualitatively in accord with the results

apparatus operating at potentials above one million volts has been developed.

SUMMARY

1. Any beam of x-rays or gamma rays contains high speed secondary electrons

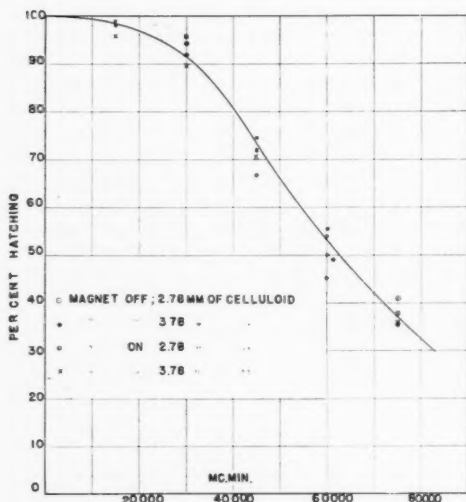


Fig. 8. Survival curves of *Drosophila* eggs exposed to gamma rays through 2.78 or 3.78 mm. of celluloid, with and without magnetic field.

of the ionization measurements previously described. A quantitative agreement could not be expected, of course, on account of the marked difference in experimental conditions. It is evident that a gamma-ray beam partly stripped of the accompanying secondary electrons is considerably less effective biologically than one containing the full complement of electrons. The acquisition of additional electrons takes place rather rapidly as the beam traverses matter, but nevertheless the difference is considerable within the first one or two millimeters of tissue. If erythema and epithelitis are due to tissue damage which occurs within this depth range, the removal of secondary electrons from a beam of very hard radiation may be expected to prove of considerable practical value in radiotherapy. However, full advantage of this phenomenon cannot be taken until x-ray

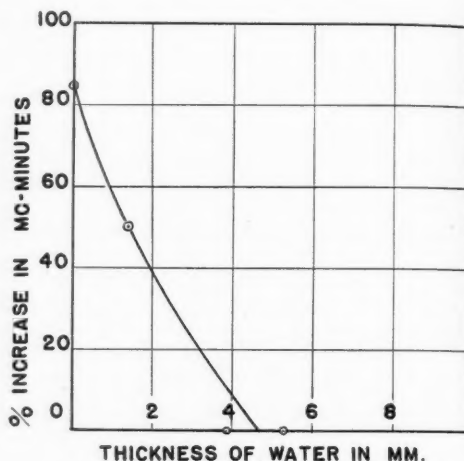


Fig. 9. Relative increase in millicurie-minutes necessary to produce the same lethal effect on *Drosophila* eggs through different thicknesses of material, when magnetic field is on.

originating in the filter and air traversed by the radiation. These electrons are responsible for the ionization produced by the radiation. In turn, ionization is responsible for the biologic action of radiation. Thus if it is possible to remove the secondary electrons from a beam of radiation, its biologic effectiveness should be reduced considerably.

2. Secondary electrons may be removed from a beam of radiation by means of a magnetic field suitably applied. They may also be removed to a considerable extent by proper canalization of a narrow beam, on account of the fact that they do not travel in straight lines.

3. When a beam of radiation stripped of secondary electrons traverses a tissue, it gradually acquires secondary electrons due to the interaction of radiation and matter, and beyond a certain depth it contains the appropriate quota of electrons consistent

with the physical characteristics of the radiation and medium. Accordingly it is only within a certain layer of tissue on the incidence side that a subnormal degree of ionization may be expected. The thickness of this tissue layer depends on the quality of the radiation which determines the penetration range of the secondary electrons. In the case of ordinary x-rays the range in tissue of the secondary electrons is very short and the tissue layer of subnormal ionization is very thin. In the case of gamma rays it is of the order of a few millimeters.

4. Skin damage of the degree tolerated in present-day radiation therapy is probably limited to the epidermis, inasmuch as there is eventually almost complete recovery. The thickness of the human epidermis varies from point to point but, in general, it is well within two millimeters. Accordingly, by removing the secondary electrons from a beam of gamma rays before it reaches the skin, one may expect to reduce skin damage considerably.

5. Physical experiments described in the body of the paper show that in the case of gamma rays the tissue layer of subnormal ionization is about four millimeters.

6. Biologic experiments with *Drosophila* eggs as test objects confirm this result, and demonstrate that the biologic effectiveness of gamma rays is markedly reduced by the removal of secondary electrons.

7. It has been impossible to test by actual experiment the decrease in skin damage resulting from the removal of electrons from a gamma-ray beam, due to the fact that the amount of radium required for this purpose (of the order of twenty grams) is not available.

8. It is suggested that practical application of the findings reported here be made to

supervoltage x-ray therapy at voltages in the neighborhood of one million. The advantage may be expected to be greater with still higher voltages.

9. The experimental demonstration of the marked reduction in the electron content of a gamma-ray beam by suitable canalization and spacing of filters, facilitates the practical application of the principle.

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ROENTGENOLOGIC FINDINGS OF POST-TRAUMATIC SEQUELAE OF HEAD INJURIES

AN ENCEPHALOGRAPHIC STUDY¹

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It is a well-recognized fact that, after recovery from the acute effects of a head injury, many patients continue to show symptoms, or later develop symptoms, which are apparently the result of the trauma. In some instances, there are such general symptoms as headaches, vertigo, sleep disturbances, and mental changes; while in others, there are clinical signs of focal organic damage to the central nervous system.

In a review of 255 cases observed for a period of from one to five years after head injury, Glaser and Shafer found that 80 per cent developed subjective symptoms, and 32.5 per cent developed organic neurologic signs. Mental disturbances and "convulsive states" were the only symptoms that developed more than three months after the injury, all other symptoms appearing within a short time. Neurologic signs, it was noted, were much more frequent in cases with depressed fracture of the vault than in cases without skull fracture. The highest percentages of both signs and symptoms were seen following fractures of the base and vault. It is unfortunate that, in this very interesting study of the sequelae of head injuries, roentgenographic observations were made only in order to ascertain the presence and location of skull fractures; but no encephalographic studies were made.

In spite of the increasing use of encephalography, its value in the study and evaluation of the sequelae of head injuries appears to be but little appreciated. Many recent reviews of such sequelae, though none of as large a series as that of

Glaser and Shafer, fail to mention the use of encephalography (see Bing, Dickerson, Gordon, Horrax, and Stone and Brams). In 1935, Wechsler reported a series of 100 cases showing symptoms attributed to a previous head injury; the majority were litigation cases. All these patients, he notes, had records of roentgenographic examinations of the skull, "a great many" records of lumbar punctures and "a few had reports of encephalographic studies"—but he does not discuss these records further. He recognizes the value of encephalographic studies as made by others, however, in showing "the extent of ventricular and brain changes in patients whose main complaints were of a subjective nature." In this series of 100 patients, he further notes, 74 had subjective complaints and only 26 had "major or minor evidence of organic involvement of the nervous system."

In 1925, Foerster and Wartenberg, and in 1926, Schwab reported encephalographic studies on patients who showed symptoms after head injuries. The patients studied showed such symptoms as fatigue, insomnia, headache, dizziness, etc., but no marked objective neurological signs, yet the encephalograms showed definite evidence of damage to the brain. In 1930, Pancoast and Fay, and Foerster and Penfield reported similar findings (Friedman).

In 1931, Swift reported a study of 100 cases of post-traumatic sequelae resulting from head injuries; 76 of these patients had been unable to resume work after the injury. The chief symptoms were headache, dizziness, general weakness, disturbances of vision and hearing. Encephalographic studies were made in 50 cases. Of these, 27 showed "practically normal" findings; two showed displacement of the ventricles to the left; four showed dilata-

¹ I am greatly indebted to Dr. Foster Kennedy, of the Neurological Department, and to Dr. K. M. Bowman, of the Psychopathic Division of Bellevue Hospital, for the use of the clinical data, and also to Dr. Lewis J. Friedman, Director of the X-ray Department of the same institution, for his kind co-operation.



Fig. 1.

Fig. 1. Case 1, Patient N. S., male, aged 49. Encephalogram shows compression of right lateral ventricle and displacement of ventricular system toward the left. *Note:* Patient with no adequate history presents classical signs and x-ray findings of subdural hematoma.



Fig. 2.

Fig. 2. Case 2, Patient S. O., male, aged 40. Encephalography discloses moderately enlarged right lateral ventricle. *Diagnosis:* laceration; edema of brain with minimal subdural hemorrhage.

tion of ventricles; four showed compression of ventricles, and 13 showed air over the cortex of the frontal lobes.

In 1932, Flügel reported 38 cases showing symptoms of varying periods after the injury, which in the majority of cases was more than a year. In seven of these the ventricles failed to fill with air; in 12 there was displacement of a ventricle; in 20 cases one lateral ventricle was larger than the other; in 15 cases the third ventricle was not demonstrated, and in one case it was dilated. In this series of cases one-third of the patients showed no objective neurological signs; another one-third had epileptic seizures.

During the same year, Hauptmann reported encephalographic studies in 40 cases with post-traumatic sequelae, but without localizing signs of brain injury. In most instances, the encephalograms were made four or more years after the injury. The ventricles were dilated in 27

cases; one lateral ventricle alone dilated in 12 cases; the third ventricle alone di-



Fig. 3. Case 3, Patient F. G. Encephalograms in October, 1936, disclose bilateral dilatation of ventricular system. Mid-line shift toward right side, associated with slight deformity of left lateral ventricle.



Fig. 4.

Fig. 4. Case 4, Patient T. K., male, aged 36. Postero-anterior view. Encephalography reveals enlarged asymmetrical ventricles. *Diagnosis:* post-traumatic brain atrophy.

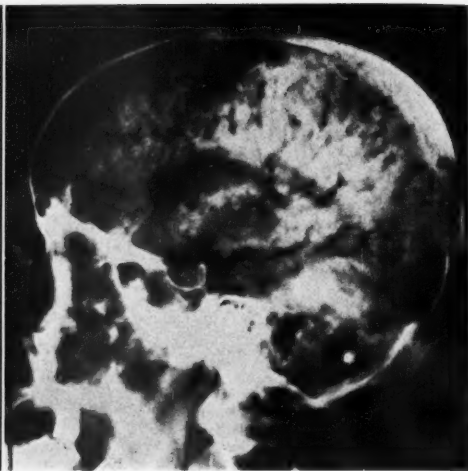


Fig. 5.

Fig. 5. Case 4, Patient T. K. Lateral view. Encephalography illustrating the coarse sulci plus dilated ventricles.

lated in two cases; rounding of the horn of a ventricle in three cases; displacement of one ventricle in six cases; failure of one

ventricle to fill in four cases; failure of both lateral ventricles to fill in two cases. Hauptmann further notes that displace-



Fig. 6.

Fig. 6. Case 5, Patient T. O'C. *Comment:* This case illustrates the therapeutic as well as diagnostic value of encephalographic study. *Diagnosis:* post-traumatic syndrome following fractured skull, due to meningo-cerebral adhesions.



Fig. 7.

Fig. 7. Case 6, Patient J. R., male, aged 37. Encephalography discloses somewhat enlarged left ventricle. *Diagnosis:* post-traumatic sequelae from lacerated brain. *Note:* Another case illustrating relief after encephalograms.

ment of a ventricle is observed more frequently in cases with localizing symptoms and attributes this to a healing fibrosis in small hemorrhagic areas or areas of softening resulting from the injury.

Money and Susman, of the University of Sidney, Australia, reported encephalographic studies in two cases with sequelæ of head injury. In both cases there was a large collection of air and cortical shrinkage in the area of the trauma. In one case, the air-filled area was divided and incompletely shut off by arachnoid adhesions, indicating a cyst formation. Excision of the cyst and scar tissue relieved the symptoms.

In 1930, Friedman, of the Neurological Service of Bellevue Hospital, New York City, reported an encephalographic study of four cases with traumatic sequelæ, and in 1932 a study of 16 additional cases, making a series of 20 cases in all. In this group of cases, eight showed definite evidence of fracture of the skull and two possible evidence of fracture. Two others had shown subarachnoid bleeding following the trauma, but in most of the cases there was neither skull fracture nor subarachnoid bleeding. There were nine cases of post-traumatic epilepsy and six cases with objective signs of a residual focal lesion in the brain; in the others the symptoms were subjective—chiefly headache, dizziness, and weakness. In only one of the 20 cases was the encephalogram normal. In the other cases, the changes demonstrated were dilation of the ventricles, considerable accumulation of air on the convexity of the brain, and attraction of the ventricular system toward the site of the lesion. These changes were found either separately or in combination. In some instances, one lateral ventricle showed more dilatation than the other. There were three cases with ventricular migration. These findings show that not only in cases with signs of local disease after brain injury, but also in cases with general symptoms, including so-called "traumatic neurosis," definite organic changes can be visualized in the encephalogram.

Grant reported a series of cases studied by ventriculography and encephalography, and included in his encephalographic se-

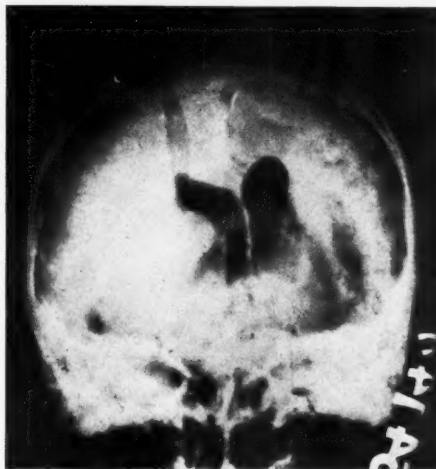


Fig. 8. Case 7. Patient J. McS., male of middle age. Left intracerebral hemorrhage. X-ray findings: simulated brain tumor; deformity of left lateral ventricle, with mid-line shift of ventricular system to the right.

ries, 51 cases of post-traumatic epilepsy, 41 cases of post-traumatic headache, and 19 cases of other post-traumatic sequelæ. He notes that in the 51 cases of post-traumatic epilepsy, the encephalogram was normal in five cases, 28 showed varying degrees of atrophy, and 18 arachnitis. In the 18 cases of arachnitis, seven showed ventricles dilated with bilateral arachnitis in the subarachnoid space; six showed normal ventricles with unilateral arachnitis, and five revealed bilateral arachnitis with one ventricle dilated. In the 41 cases with post-traumatic symptoms, six had normal encephalograms; 32 showed atrophy, and three showed arachnitis which was symmetrical. In the 32 cases of atrophy, the ventricles were normal and only the subarachnoid spaces dilated in 21.

In 1933, Bennett and Hunt reported eight cases with post-traumatic sequelæ after relatively minor head injuries. In all these cases, encephalograms disclosed "pronounced cerebral damage." The most frequent findings were obliterative arachnoiditis and cortical atrophy.

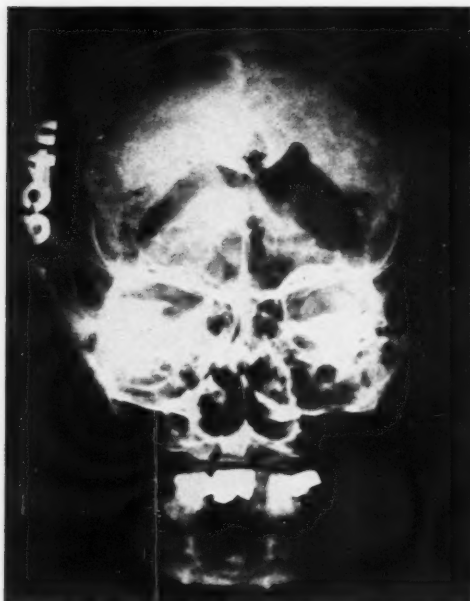


Fig. 9.

Fig. 9. Case 8, Patient N. Q. Encephalograms Aug. 3, 1935, disclosed dilated left lateral ventricle with dilated subarachnoid spaces over left side. (Left internal carotid ligated in 1927.) *Impression:* post-traumatic brain porencephaly.



Fig. 10.

Fig. 10. Case 8. Irregular collections of air pockets surrounding the dilated left ventricle. *Impression:* brain atrophy; post-traumatic.

In 1934, Lippens and Desjardin reported three cases studied by encephalography. In one case the findings were nor-

mal; in one the lateral ventricles were displaced toward the site of the injury, and in one there was deformity and displace-

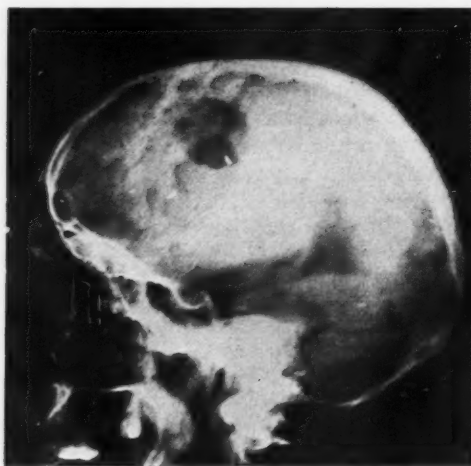


Fig. 11.

Fig. 11. Case 9, Patient J. C. Encephalograms reveal incompletely filled and deformed right ventricular system. Left ventricular system not demonstrated. Right- and left-sided craniotomies discerned. *Diagnosis:* bilateral subdural hematoma.



Fig. 12.

Fig. 12. Postero-anterior view of same case.

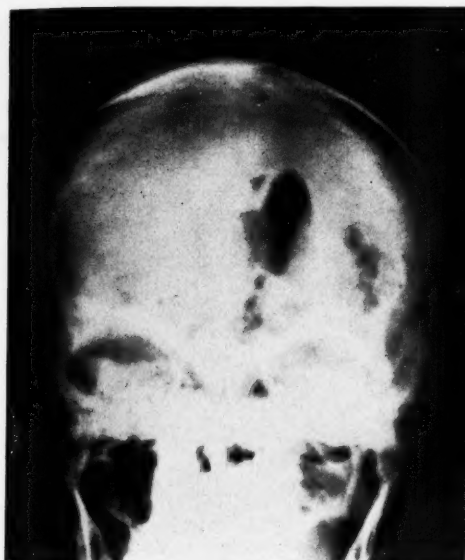


Fig. 13.



Fig. 14.

Fig. 13. Case 10, Patient R. S., male, aged 50. Encephalograms disclose dilated and deformed left ventricle with marked mid-line shift to the left. No air revealed in the cortical pathway. *Diagnosis:* subdural hematoma on right side. *Comment:* subdural hemorrhage is frequent in chronic alcoholics with many falls (often simulates psychosis).

Fig. 14. Case 11, Patient C. C. Encephalography reveals moderate dilatation of lateral and third ventricles, most marked on right side. Frontal sulci coarse. Basal cisterna enlarged. *Conclusions:* post-traumatic cerebral trophy.

ment of the left ventricle due to an old calcified hematoma.

epilepsy, distortion and wandering of the ventricles occur and are "indicative of scarring."

Glaser, in 1934, notes that, in traumatic

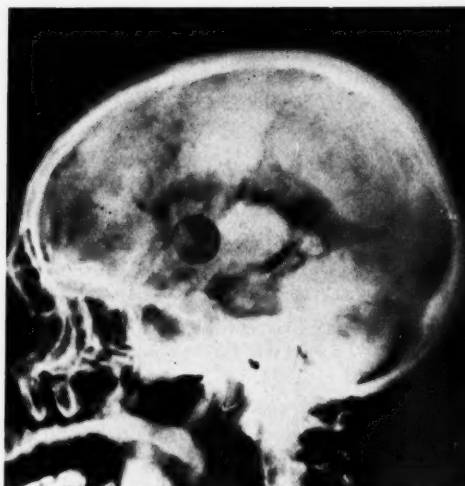


Fig. 15.



Fig. 16.

Fig. 15. Case 12, Patient I. K., male, aged 60. Lateral view. Encephalography discloses enlarged left ventricle; craniotomy discerned. *Diagnosis:* post-traumatic brain atrophy.

Fig. 16. Case 12. Postero-anterior view.

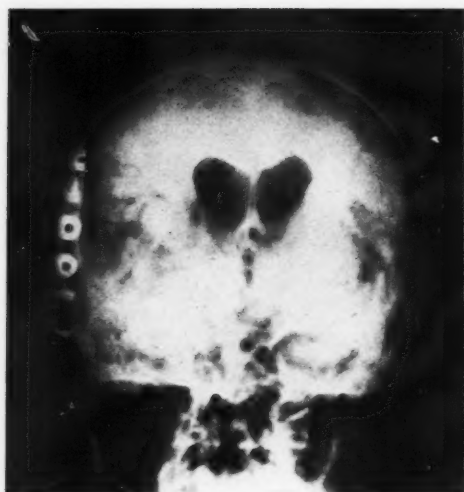


Fig. 17.



Fig. 18.

Fig. 17. Case 13, Patient H. S., male, aged 38. Postero-anterior view, disclosing enlarged ventricles.
 Fig. 18. Case 13. Encephalography reveals symmetrically distended ventricular system, cerebral sulci coarse in frontal region. *Diagnosis:* post-traumatic brain atrophy.

It will be noted that in these various reports, nothing is said of the encephalographic findings in subdural hematoma. This is generally considered to be an unusual complication of brain trauma. But Leary, the Medical Examiner of Suffolk County, Massachusetts, in his investigations of the many deaths by violence concluded that subdural hematoma occurs more frequently than has been supposed. He reported a series of 50 cases mostly the result of trauma, in none of which were encephalographic studies made. He stated that the diagnosis of subdural hematoma is often difficult. In some of these cases of subdural hematoma, death occurred soon after the injury, but in others the condition became chronic. In both types, in cases in which there resulted membrane formation, the lesion was situated over the cerebral convexity "almost without exception," and usually in the fronto-parietal region. In one of the cases reported by Friedman, operation was performed, because of the presence of focal signs, before the encephalogram was made, and no hematoma was found. The encephalogram, made later because of the persistence of symptoms, showed dilatation of the ven-

tricles, more pronounced on the right with migration of the ventricular system to the site of the lesion; the final diagnosis was post-traumatic cerebral scar.

In 1932, Gardner reported seven cases of traumatic subdural hematoma. No encephalographic studies were made in these cases. Five of these patients recovered following operation, and two died with the condition undiagnosed. Lateralizing signs, he notes, "are not of great significance, since the lesion is often found on the side opposite to that which is indicated by the symptoms."

W. D. Abbott in 1936 reported a series of 16 cases of subdural hematoma; the chief symptoms noted were headache, personality changes, convulsions, and vomiting. Encephalography was done in six of these cases, where it "was necessary for localization." In the 15 cases operated on there were four deaths.

In 1931, Lindemulder reported a case of subdural hematoma probably due to slight cerebral trauma, as the patient was struck on the head on two occasions, five and three months previously. The encephalogram showed a dilated left ventricle and a small compressed right ventricle, with displace-

ment of both ventricles to the left, and "little if any subarachnoid air over the right cerebral cortex." At operation a large subdural hematoma was removed from the right side, after which the patient made a

the lesion, with compression and deformity of the ventricle on the side of the lesion, or (in one instance) a failure to demonstrate this ventricle at all. Failure of the subarachnoid space to fill on the side of the



Fig. 19. Case 14. History of trauma; no fracture of skull. Encephalographic observation discloses presence of large collections of air in fronto-parietal regions. Case illustrates air in subdural spaces but no evidence of brain atrophy.

good recovery. Lindemulder stated that "the demonstration of a subdural hematoma by encephalography is rare." He noted but one other case, reported by Dickerson, in 1929.

At a meeting of the New York Neurological Society in 1936, Dyke reported an encephalographic study in a case of subdural hematoma, in which the encephalogram showed a large collection of air in the subdural space over the left cerebral hemisphere projecting ventrally and laterally. No air was found in the subarachnoid space or in the ventricles. The diagnosis of subdural hematoma was confirmed at operation.

In our own experience, we have found encephalography of definite value in the study of post-traumatic sequelæ, and particularly in the differential diagnosis of subdural hematoma.

In a recent series of 14 cases with post-traumatic sequelæ of head injuries, from the Neurological and Psychopathic Divisions of Bellevue Hospital, there were four cases of subdural hematoma (confirmed by operation). The encephalographic studies in these cases revealed a marked shift of the ventricular system to the side opposite

lesion was also discerned in another instance.

In only one case was a diagnosis of subdural hematoma made pre-operatively which could not be confirmed at operation. In this case, a second operation was performed and a cannula inserted into the left temporal area. This disclosed a drop of dark brown fluid, indicating an intracerebral hemorrhage, with coagulation of the blood. The patient made a good recovery. The pre-operative encephalogram showed a definite shift of the ventricular system to the right—the side opposite the lesion—on which the diagnosis of subdural hematoma was based, but further study of this encephalogram showed that the characteristic deformity of the ventricle on the side of the lesion was not present.

In the remaining nine cases, there was roentgenologic evidence of brain atrophy. In three cases there was enlargement of both lateral ventricles, and in two of these a corresponding dilatation of the third ventricle. In all three cases the cerebral sulci were coarse, an indication of cortical atrophy, and in one case the basal cisternæ were enlarged, showing atrophy of the adjacent structures. In this latter case

one of the lateral ventricles was slightly larger than the other. In five of these nine cases, one lateral ventricle was dilated and the sulci were coarse; in one case porencephaly was noted. In these five cases,

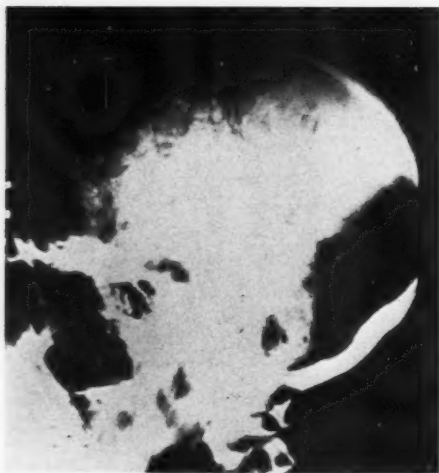


Fig. 20. Case 15, Patient C. B. Encephalograms reveal large collection of air in posterior fossa. *Diagnosis:* post-traumatic cerebellar atrophy.

there was almost complete relief of symptoms following encephalography. Any displacement of the ventricle in these cases of cortical atrophy was toward the site of the lesion, due to cortical fibrosis. In one case—in which the exact diagnosis was doubtful—there was air in the subdural space but no evidence of brain atrophy.

SUMMARY

Symmetrical filling of the ventricles and subarachnoid spaces, or dilatation of one or both ventricles without a ventricular shift definitely rules out a subdural hematoma in our experience. It should be noted also that, in subdural hematoma, the ventricular shift is *away from* the side of the lesion, while in the presence of scar tissue resulting from a laceration of the brain there may be a ventricular shift *toward* the lesion. As the clinical symptoms of subdural hematoma may simulate those of other post-traumatic sequelæ, the differential diagnosis is of importance, for surgical

treatment is definitely indicated in subdural hematoma. The earlier the operative interference, the better the results. In other cases with similar clinical symptoms, surgery may be definitely contraindicated. The encephalogram is also of value in the localization of a subdural hematoma, for the localizing signs and symptoms are often confusing.

Encephalography has been used chiefly in the study of post-traumatic sequelæ of brain injury to determine whether or not there is an actual brain lesion to account for the subjective symptoms which are sometimes designated as neurotic. In a large percentage of such cases, actual lesions are demonstrable by this means. We would urge the more general use of encephalography following brain injury for a more exact differential diagnosis of the resulting lesions, especially with a view to determining whether or not surgery is indicated.

Encephalography by the usual technic is not harmful in patients with sequelæ of brain injury. It may be of definite therapeutic value, not only in patients with adhesions but also in patients with cortical atrophy. Marked improvement in symptoms may result from the injection of the air. Bennett and Hunt noted that there was relief of symptoms following encephalography in about half of their cases. Grant noted that 50 per cent of his cases of post-traumatic headache observed over a period of from 12 to 24 months were relieved by encephalography, and a smaller percentage of cases of post-traumatic epilepsy were also relieved. We have also noted definite relief of symptoms in many of our cases following encephalography.

CONCLUSIONS

The reports cited and our own cases show the very definite value of encephalography in the study of post-traumatic sequelæ of brain injuries. The encephalogram has demonstrated that even subjective symptoms may have a definite organic basis resulting from injury to the brain tissue. It is of special aid in differen-

tiating subdural hematoma from non-surgical lesions. It may aid in localizing a subdural hematoma. It has the added advantage, of being of frequent value, as a therapeutic measure.

309 West 103d St.

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ROENTGEN ANALYSIS OF THE SPINE

WITH DESCRIPTION OF SOME NEW TECHNICAL INSTRUMENTS

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DESPITE the general advance in x-ray technic, the improvement of x-ray machines, and the greater sensitivity of the films, there is still room for much improvement in the radiography of the spine. It has been my experience that radiography of the spine lags behind that of other parts of the body. In recent years the need for more efficient and more detailed roentgenograms of the spine has been generally recognized by the profession, especially in the fields of orthopedic and traumatic surgery. This constantly growing demand has not yet been satisfactorily met.

To mention a few instances: fractures and dislocations of the cervical spine require lateral views without distortion, showing the entire cervical spine from the first cervical to the third dorsal vertebra. It was only a short time ago that Byron Stooky (6) deplored the difficulty of obtaining well defined roentgenograms of the cervical spine in cases of fracture and dislocation.

For the analysis of scoliosis and the evaluation of the results of various types of treatment, radiographs have to be taken with the patient in a standing position, and if possible in such a way that all the details of his position may be recorded and check-up x-rays taken under exactly identical conditions.

More and more attention has been given recently to the pathology of the small joints of the spine and the intervertebral facets forming these joints, and the conviction has grown that arthritis or arthrosis of these small joints may be of greater importance than the more conspicuous changes in the intervertebral discs and the vertebral bodies, *e.g.*, in spondylosis. This is especially true of the lumbosacral region in the perplexing problem of lower back pain.

The spine does not lend itself so easily to roentgenography as do other parts of the body, the extremities for instance, and this is due chiefly to its anatomy. The spinal column is very large in its longitudinal dimension and very small in the other two. It is situated within the trunk and the pelvis in such a way that it is not easily revealed by the x-ray without interference from overlying structures. Furthermore, the spine has a number of natural curves, which are frequently increased by deformities; therefore, various sections of the column have a different object-film distance. Finally, the single units of the spine are so constructed that certain details such as the small intervertebral joints or the pedicles, which may be of the greatest interest, cannot be visualized in one and the same exposure.

Another difficulty arises in attempting to radiograph the whole spine, or a sufficient part of it, on one film when the usual small film-focus distance is used. Not only does a film-focus distance of less than one meter allow but a small section of the spine to be radiographed at one time, but it can show only a few vertebrae without distortion, the majority of them being so far off-center that they do not permit accurate observation.

The desire to have a complete picture of the entire spine on one film has led to the use of a 14 × 36-inch film and a Potter-Bucky diaphragm of the same size. In order to eliminate the difficulties caused by the various densities of different sections of the body, Arthur W. Fuchs (2) introduced an ingenious filter which seems to give satisfactory detail throughout the spine; it does not, however, eliminate distortion as long as it does not increase the film-focus distance to more than 54 inches.

In the following, I should like to report

methods which we have used and developed during the last six years, and which in our hands have given excellent results.

- (4) Right and left oblique views of the lumbosacral spine showing the intervertebral joints.

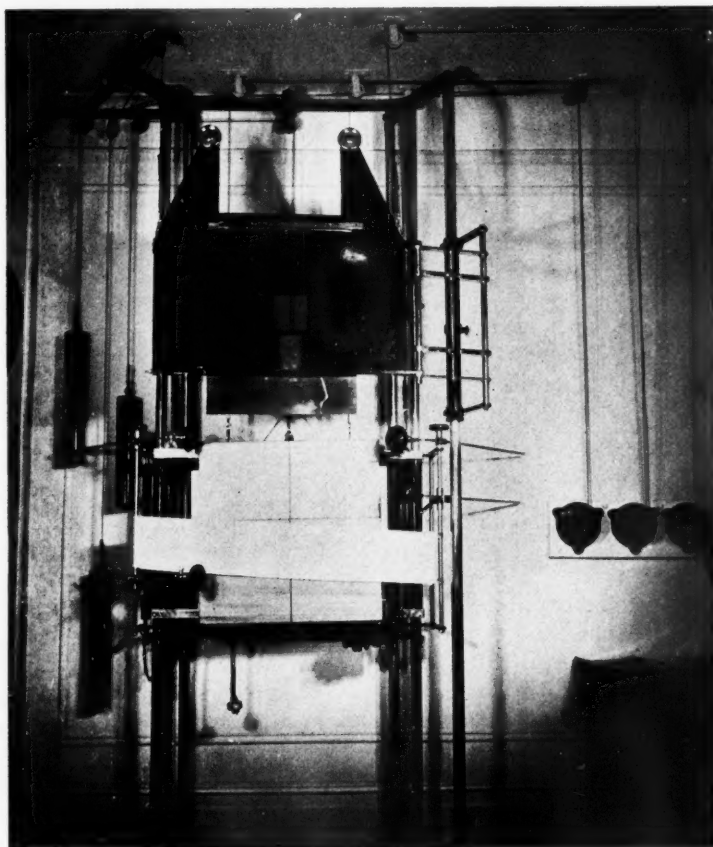


Fig. 1.

In working out these methods, I always have in mind that it is necessary to standardize the technic in order to facilitate the routine work of the x-ray department.

A complete roentgen analysis of the spine consists of the following exposures:

- (1) Anteroposterior and lateral long-distance views of the lumbodorsal spine, with the patient standing or sitting.
- (2) Anteroposterior and lateral long-distance views of the cervical spine, with the patient sitting.
- (3) Anteroposterior cone film of the lumbosacral and sacro-iliac region.
- (5) Right and left oblique views of the dorsal spine showing the intervertebral joints in this region.

(1) In taking the anteroposterior and lateral views of the entire spine, or at least the lumbodorsal section, we follow the technic of Walter Jaeger, which was first published in 1931 (3 and 4). The underlying principles of teleradiography of the spine are as follows:

By making the film-focus distance two meters or more, the relation of focus-film to object-film distance is so favorable, for obvious geometrical reasons, that the spine, in spite of its anatomical position within

the trunk, and its curvatures, is depicted on the film practically without distortion. Therefore, the exposure obtained may be

long exposure; therefore, a motor-driven Potter-Bucky diaphragm, which permits any length of exposure, is used. A

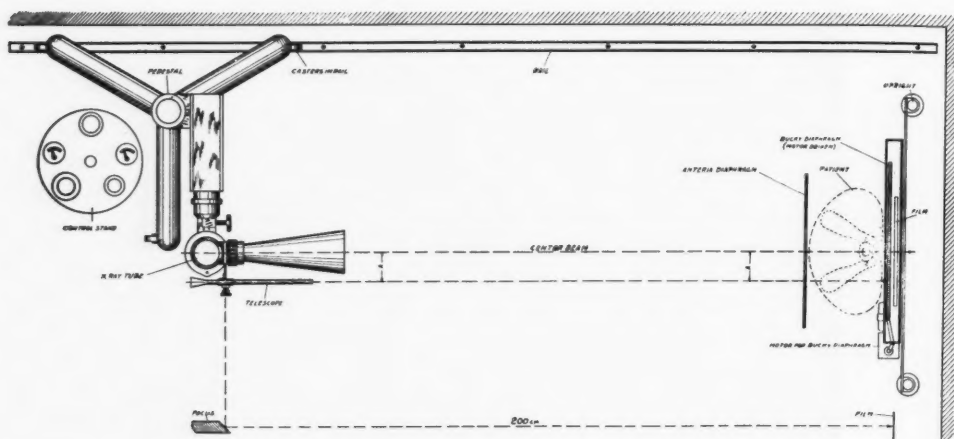


Fig. 2.

used for the determination of the axes of the vertebral bodies as well as the axis of the entire spinal column.

There is, however, another feature which makes the long-distance radiogram of the spine even more valuable: By increasing the film-focus distance to two meters or more, a very interesting phenomenon appears, a "compensating effect" (*Ausgleichseffekt*—Jaeger). Without the use of additional filters, as employed by Fuchs, the entire spine is shown on the film with very little variation in density. The idea of taking long-distance radiographs of the spine with regard to this compensating effect was, so far as I have been able to find, first used by Baer, of Zurich, in 1916. Jaeger reports that Denis Mulder, of Bandoeng, Java, has taken roentgenograms of an entire person with a film-focus distance of from eight to twelve meters, thereby obtaining a complete "compensating effect," the patient's hair and nails being just as well defined as were the large bones of the body.

In order to standardize and simplify the teleradiography of the spine, certain technical arrangements have to be made. The long film-focus distance necessitates

second diaphragm is added in front of the patient in order to eliminate as much of the secondary radiation as possible, thereby giving the film the maximum contrast. Following the example of Jaeger, we have made the following arrangements:

Three pairs of pillars carrying the upright Potter-Bucky diaphragm, the compression band and other means of fixation for the patient, and the anterior diaphragm are provided (Fig. 1). The distance and relative position of the tube, film, and object are permanently fixed in a rectangular position, as shown in Figure 2. This diagram illustrates the position of the patient between the anterior diaphragm and the Potter-Bucky. The height of the whole system varies according to the patient's size. All the uprights are graduated in order to facilitate the adjustment and to record it.

The long film-focus distance and the narrow opening of the anterior diaphragm necessitate the most exact centering of the entire system, and especially of the focus. For this purpose I have designed a *telescope* (Figs. 3 and 4). This consists of a rectangular metal tube (B), 1 cm. in diameter and 31 cm. long, which carries

at one end an eye-piece (A). The interior of this tube is black so as to eliminate glare. Seven centimeters from the distal

end, is used. In taking the anteroposterior view of the cervical spine, the patient sits on the stool so far away from the frame

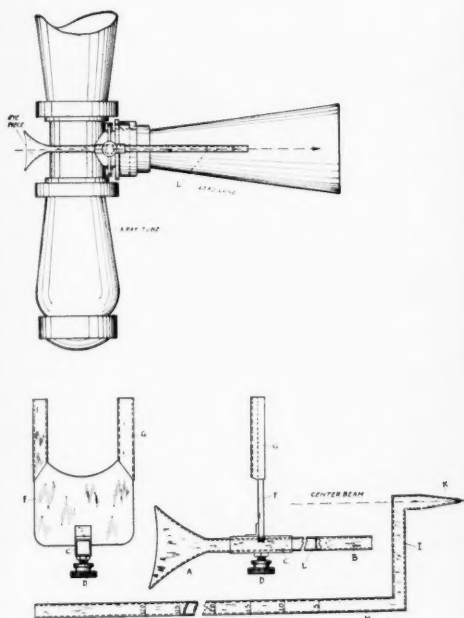


Fig. 3.

end, there is a cross-wire (L). The telescope is attached to the tube exactly parallel with the center beam. With this little device it is very easy to center the focus on the object.

As a rule, the anteroposterior view is taken with the patient sitting on a stool centered to the midline of the upright Potter-Bucky diaphragm. The sitting position has the advantage of overcoming the lumbar lordosis by flexing the hip-joints. For the examination of scoliosis, and also for control of the action of spinal braces, the anteroposterior views are taken with the patient standing.

(2) *The Cervical Spine.*—The anteroposterior and lateral views of the cervical spine are taken with the patient sitting, and without the use of the Potter-Bucky diaphragm. The anterior diaphragm, how-

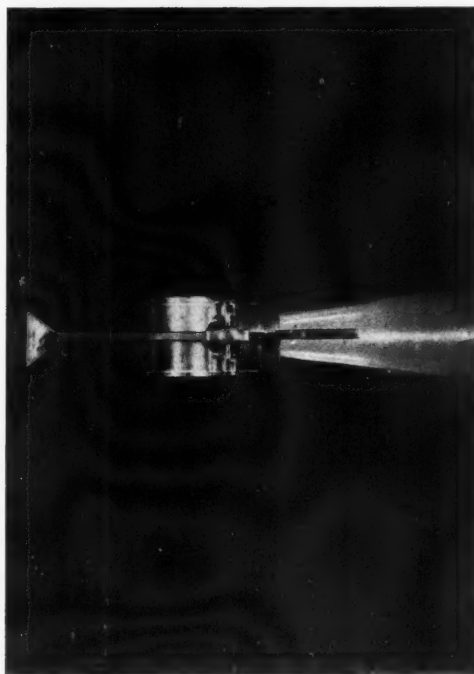


Fig. 4.

ever, is used. In taking the anteroposterior view of the cervical spine, the patient sits on the stool so far away from the frame that it will be possible to get his neck in close contact with the cassette. The patient is instructed to open and close his mouth rhythmically during exposure so as to dissipate the contour of the jaw. In order to obtain a good lateral view, the sagittal plane of the patient's skull and cervical spine must be perfectly parallel with the film. Fixation in the desired position is maintained by the old Baer "skull ring" (Fig. 5).

(3) *The Lumbosacral Region.*—There are three requirements for obtaining satisfactory films of the lumbosacral junction and the sacro-iliac joints: (a) the lumbar lordosis must be straightened out in order to have this section as close to the film as possible; (b) secondary radiation must be cut down to a minimum in order to get good contrast, so that in addition to the

Potter-Bucky diaphragm a small cone and a strong compression of the soft parts must be used, and (c) the patient must be cleaned out thoroughly, with special attention to gas formation.

the patient has to rest on either side, with the frontal plane of his body at an angle of 45 degrees to the plane of the film.

(5) *The Dorsal Region.*—Finally, the intervertebral joints of the dorsal spine are

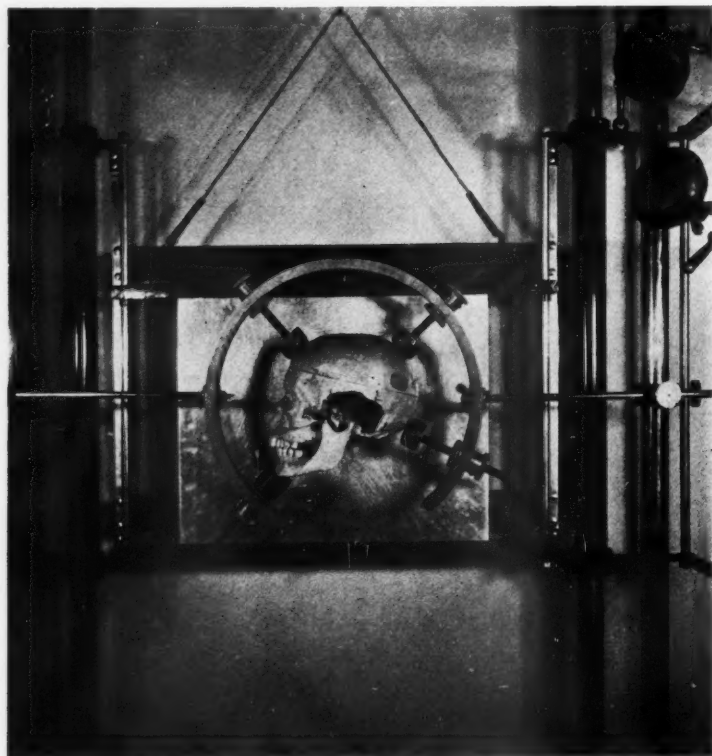


Fig. 5.

Lumbar lordosis is flattened out by flexing and abducting the legs at the hip-joints, as in the lithotomy position (7). The center beam has to be vertically on the cassette. I do not approve of the much-used technic of taking a film of the sacro-iliac region by tilting the tube or the center beam to 45 degrees. By this means we may obtain a good view of the sacro-iliac joints, but we get too much enlargement and distortion.

(4) Next, the oblique views of the lumbar spine are taken with the aim of showing all the small intervertebral facets of the lumbosacral region. For this purpose,

shown with the patient lying on either side, with his body tilting 20 degrees forward from the vertical lateral position.

In order to facilitate the correct centering of the x-ray tube for the special views of the lumbosacral region and the intervertebral joints, which are all taken with the patient lying down and at a film-focus distance of one meter, I have constructed a new *center beam index*, which carries a scale of the film-focus distance, and which may be attached to or removed from the tube with one movement of the hand (Figs. 3 and 6).

Before entering into the discussion of

the advantages of the various roentgenograms obtained by the technic described, I should like to make a few general remarks.

In roentgenography of the spine more than in the routine roentgenography of the extremities, the results depend upon a very exact technic. The position of the patient for each exposure is just as important as is the correct centering of the radiation. Practically all of the special views described above throw a heavy burden upon the x-ray tube, demanding a great intensity of radiation for long film-focus distance, and long exposure time, in which it is difficult to keep the patient from moving if his position is not entirely fixed and comfortable. Correct values of kilovoltage, milliamperage, and exposure time are not so important as having the whole system properly centered and avoiding secondary radiation as far as possible. Good compression of the object, the use of the smallest cones, and for the long-distance views the use of an anterior diaphragm, help considerably to obtain better contrast. A very careful dark-room technic, with special attention to correct time-temperature

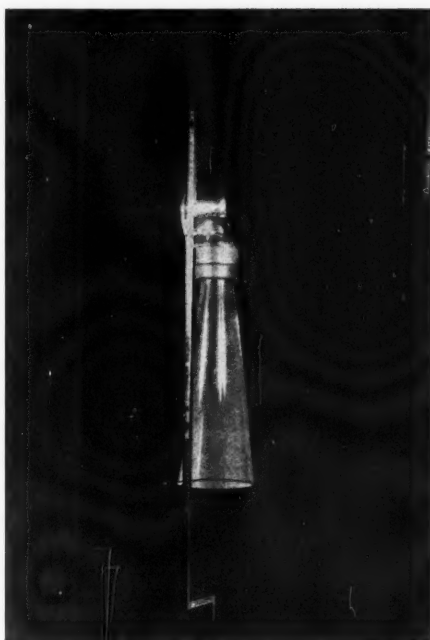


Fig. 6.

developing, is a prerequisite for such delicate x-ray work.

Proper centering of the object is pos-



Fig. 7.

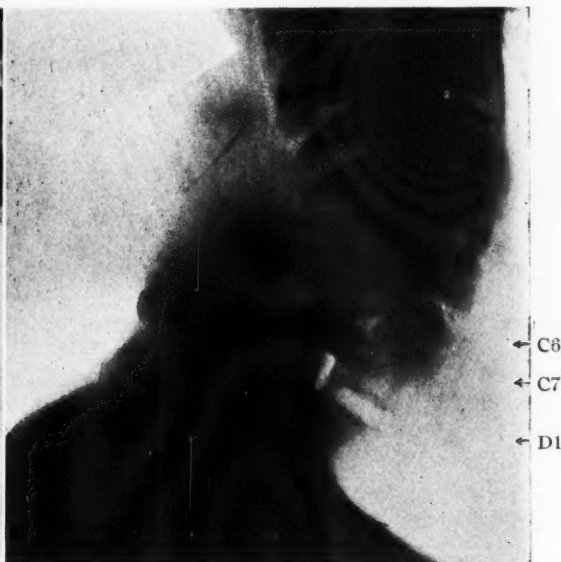


Fig. 8.

sible only if the roentgenologist or x-ray technician is well informed as to the condition of the patient and the special question that needs to be answered by the radiogram. Close co-operation between the roentgenologist and the physician in charge of the case may frequently limit

bosacral region and the two 45-degree oblique views usually give all the information required.

The two-meter long-distance view of the spine with the patient in a vertical position affords a number of conspicuous advantages. As we have already mentioned, the so-called "compensating effect" of the long film-focus distance in the large section of the spine, depicted on one 14 × 17-inch film, gives at a glance a good survey of the major part of the column. It makes variations in the number and size of the vertebræ and a difference in structure and calcium content more easily perceptible. The favorable relation between film-object and object-focus distances does away with most of the distortion and gives all the structural details obtainable only otherwise in cone views of small sections of the spine.

In cases of suspected fracture of a vertebra, clinical examination is not always successful because of the fact that the pain is frequently referred to lower parts of the spine. Long-distance views will often prevent the overlooking of a fracture of a dorsal vertebra when the pain is localized in the lumbosacral region. In re-examination of injuries to the spine, I have found on several occasions a fracture of the tenth dorsal vertebra, and even of the twelfth dorsal, which had been overlooked for many weeks because the x-ray examination had been limited to the lumbar spine.

In injuries to the cervical spine it is difficult to obtain satisfactory lateral roentgenographs in the region of the lower cervical or the upper dorsal vertebræ. In these cases the long-distance view of the cervical spine has given us the best results (Fig. 7); for instance, in a fracture of the spinous process of the seventh cervical or the first dorsal vertebra, or in a fracture dislocation of the sixth and seventh cervical vertebræ (Fig. 8).

One of the great advantages of long-distance roentgenography of the spine is the lack of distortion, which makes it possible to discover fractures of the intervertebral facets and the pedicles or neural arches,

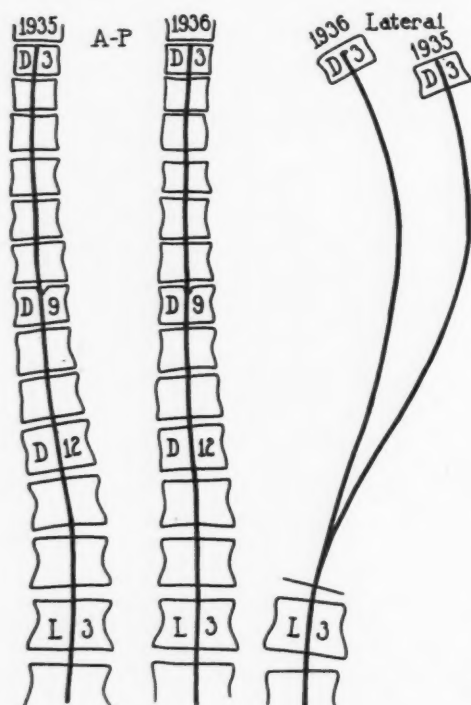


Fig. 9.

the number of x-rays that must be taken. While a complete analysis of the spine would necessarily consist of the nine standard exposures listed above, such a complete study may be dispensed with in many cases, in which the clinical diagnosis is not in doubt or in which the pathology is well localized. For instance, in the treatment of scoliosis, the anteroposterior long-distance view will frequently suffice to determine the type of brace to be applied and to check up on the efficiency of a spinal brace already in use. Or in the case of well defined lumbosacral arthritis, the special anteroposterior view of the lum-

or injuries to the intervertebral discs and minute compression fractures of vertebral bodies, by the method of determination of the axis introduced by Jaeger. The following technic is used:

a kyphoscoliosis, always show a well defined curve with no angulation, while a wedge-shaped vertebra caused by a recent compression fracture, no matter how mild, will always show a deviation of the axis,

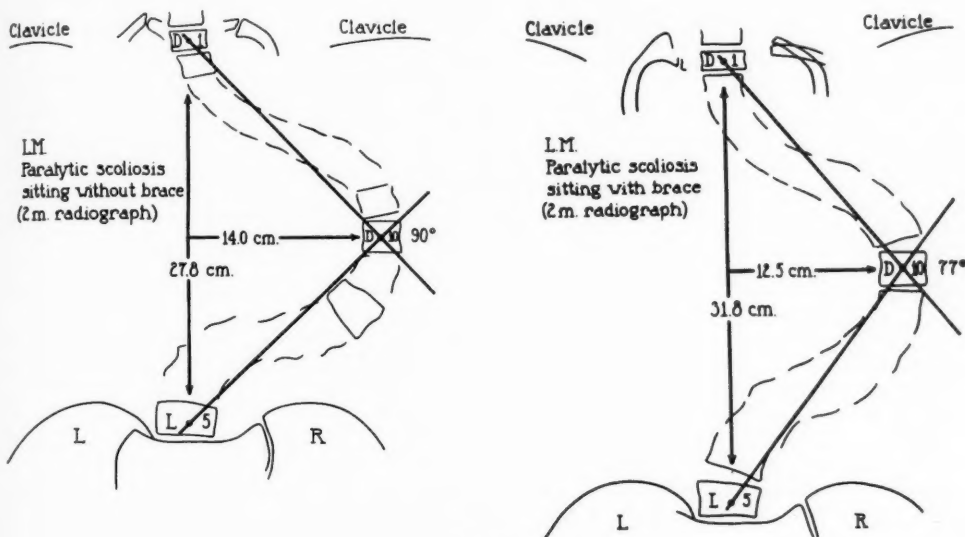


Fig. 10.

From the long-distance anteroposterior and lateral roentgenographs of the spine, a tracing is made outlining the vertebral bodies in each plane. The longitudinal axis of each vertebral body is constructed by drawing a line connecting the center of its cranial and caudal contours. The axes so obtained are connected, giving the total curve of the vertebral column, anteroposterior and lateral views (Fig. 9). Whenever this line forms an angle instead of a well defined curve, we may expect the site of some recent pathology. Jaeger has shown that by this method it is possible not only to discover the localization of a fracture of an intervertebral facet, of a pedicle, or a subluxation of a cervical vertebra, but also to discriminate between a recent injury to the spine and old changes and to follow the reconstruction of the curve in the course of healing of a fracture.

Deformities of the spine, as, for instance,

forming an angle. Wherever the determination of the axis in the tracing of the long-distance roentgenograph of the spine shows angulation, small cone views of this section are taken, including oblique views, with the result that in many cases a fracture or subluxation is found. It is obvious that this technic for determining a recent injury to the spine as compared with an old deformity is of special value in medicolegal cases. The author has frequently used this method in his capacity as Medical Referee for State Compensation and insurance companies.

In the treatment of scoliosis the importance of the analysis of the spine under weight-bearing, with the patient standing, is more and more recognized and generally used, and a vertical Potter-Bucky diaphragm is usually employed for this purpose. The long-distance method has the advantage of eliminating the distortion

which is so confusing in the evaluation of these exposures.

The arrangement of the long-distance view of the spine described above facilitates the repetition of check-up x-rays

roentgenographs of the spine are used (Fig. 10).

There is little to add in recommendation of the technic described for the anteroposterior view of the lumbosacral and

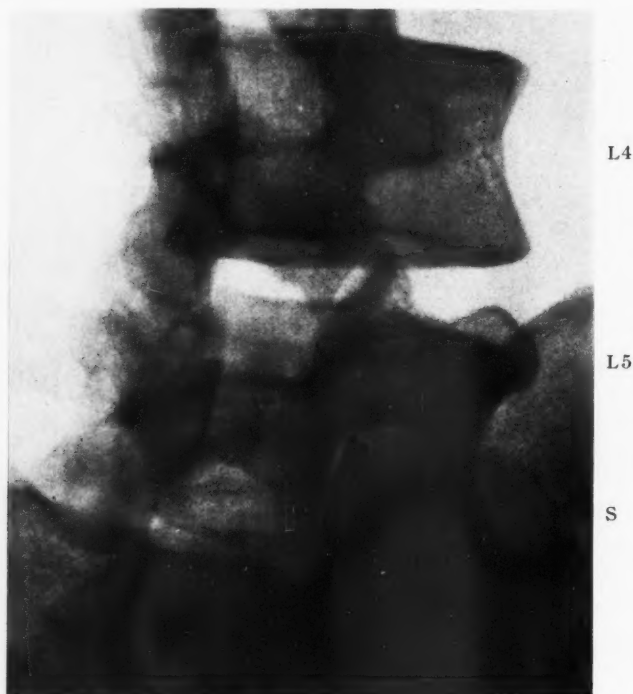


Fig. 11.

under identical conditions. Determination of the curvature by means of tracing the axes of the vertebral bodies is more accurate than other methods of measuring the angle of a scoliosis. We gain a valuable criterion for the evaluation of various treatments, which is essential to form an opinion based on facts in the discussion of operative *versus* conservative treatment of scoliosis.

In the conservative treatment of scoliosis and other spinal conditions, this method may be employed to great advantage to control the construction and fitting of spinal braces. If the method introduced by Ferguson (1) is used, it will be more accurate if tracings of long-distance

sacro-iliac region with the patient in the lithotomy position. This is, to my mind, the only way of obtaining an undistorted view of the fifth lumbar intervertebral disc and the details of the lumbosacral junction.

Deformities of this region, *viz.*, narrowing of the intervertebral discs, large osteophytes, hemisacralization, or complete sacralization of the fifth lumbar vertebra, and so on, are, in our experience, of minor importance, and are rarely a satisfactory explanation for lower back pain or a sciatica. Arthrosis and arthritis of the small intervertebral facets are, however, of prime importance as a cause of lower back pain, and should therefore be carefully investigated in every case of this type.



Fig. 11-A.

Furthermore, a joint formed between the transverse process of a sacralized fifth lumbar vertebra and the sacrum or ilium is frequently the site of a degenerative arthrosis. We may assume, as Max Lange has pointed out (5), that a gross deformity, as met with in spondylosis, very rarely causes an irritation of the nerve-roots by mechanical pressure, while on the other hand the relation of the posterior roots to the intervertebral joints is so close that an inflammation of these joints may readily spread to the nerve. Therefore, the study of the small intervertebral joints is essential. Due to the anatomical structure of the intervertebral joints in the various sections of the spine, we have to place



Fig. 12.

the patient in various positions in order to obtain an undistorted view right into the joint space. While individual variations may render this problem difficult sometimes, we have found that the 45-degree oblique position will show all the lumbar intervertebral joints, and the 20-degree tilted lateral view those of the dorsal region, in the average patient (Figs. 11, 11-A, and 12).

From the illustrations shown, it is apparent that these views reveal not only the intervertebral facets, but also many details of the neural arch and the pedicles which are not otherwise clear. We have found that these oblique views are of such value in cases of spondylarthritis and spondylarthrosis that they deserve to be included in the routine examination, even in preference to the long-distance view of the entire spine.

SUMMARY

"Roentgen analysis" of the spine represents a complete radiological study of the spine as an entity, as well as of its individ-

ual elements, with special reference to the small intervertebral joints and the complicated structure of the lumbosacral region.

The x-ray technic described in this paper has proved so successful in our hands and its application so simple that it may be used as a standardized routine procedure in every x-ray department.

Special attention has been given to teleradiography of the spine with the patient standing or sitting. The long film-focus distance of two meters makes possible a survey of the major section of the spine on one 14 × 17 inch film; the "compensating effect" gives a well defined picture of the structural details in almost all sections of the spine; the freedom from distortion permits a method of determination of the axes of the vertebral bodies and the entire spinal column, which is of im-

portance for the recognition of minor fractures and the diagnosis and treatment of deformities.

A telescope for teleradiography and a new center-beam-index are introduced.

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CARCINOMA OF THE OVARY

RESULTS SECURED BY RADIATION THERAPY¹

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CARCINOMA of the ovary being one of the most radiosensitive epithelial tumors, it is highly important to know what results are obtained by radiation treatment of this disease. While practically every patient in the series here presented had some surgical procedure—ranging from laparotomy and biopsy to attempted excision—it was not felt that the probability of cure was good in any of the cases if surgery alone was used; in many of them, since the primary tumor was not removed, the only benefit traceable to surgery was that a definite diagnosis was made available. Consequently, we feel that the principal treatment in these patients was with radiation. This is made more explicit when we state that of the 15 patients now living (for various periods), eight had definite metastases at the time of the first irradiation, while the other seven had none mentioned in the available records (but it is not known with certainty that they did not have metastases). Exact evaluation of the original clinical condition is now impossible, because of the defects in the earlier records. However, most of the patients had metastases, often peritoneal implants but occasionally distant, and several were moribund at the time of first treatment.

The age incidence (Fig. 1) shows its peak in the sixth decade, nor is it greatly changed by correcting for the distribution of the different age groups in the population. The disease is then one of late middle life, with the peak incidence just after the time of the average woman's menopause. This occurrence of the peak in relation to the menopausal age is perhaps fortuitous,

because a fair number of the cases occurred in youth or advanced age.

As diagnosis was made on the microscopic appearance of material obtained at operation or necropsy, the accuracy of our

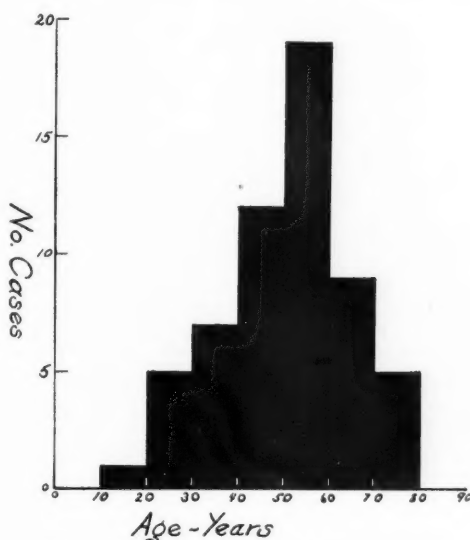


Fig. 1. Age distribution of cases reported in this paper.

diagnosis can be no better than the accuracy with which a pathologist is able to distinguish carcinoma from benign ovarian lesions. This is, unfortunately, a disputed point. It is, therefore, important to remember the weakness of this criterion. The distribution of the various pathologic types can be described only in the most elementary way (Table I), as the small number of cases and the incompleteness of the early records make proper study almost impossible. It is worth noting that in the cystic carcinomas the papillomatous outnumbered the pseudomucinous in those

¹ Presented at the meeting of the Radiological Society of Minnesota, in St. Paul, March 28, 1936.

least were in fair condition. Moreover, those who had multiple heavy courses did better than those who had only a single

the six still living who have passed the five-year mark, one has a persistent mass in the cul-de-sac which, while static, rep-

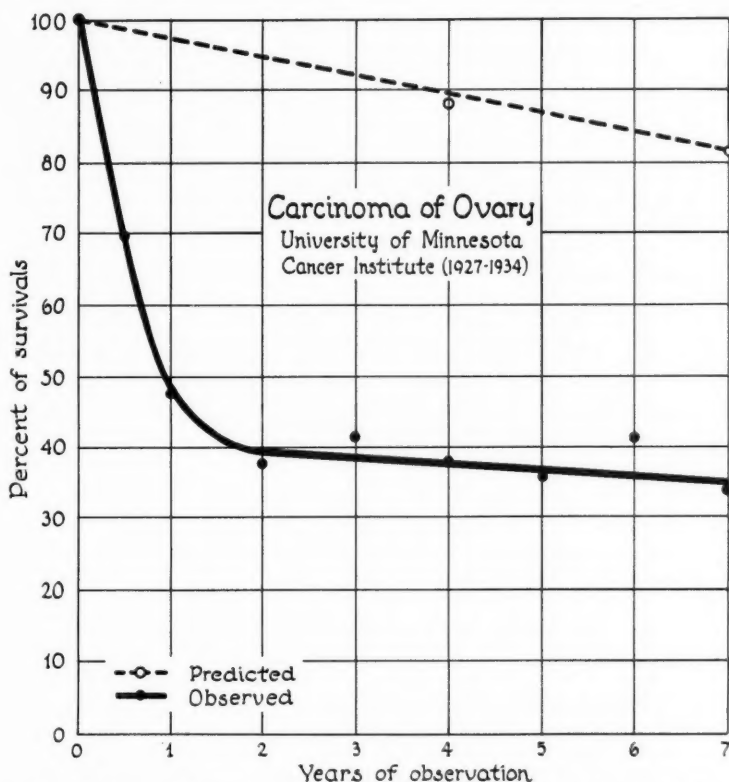


Fig. 2. Survival in carcinoma of the ovary. The upper curve (dashed) shows the average probability of survival normal for such an age group. The lower (solid) curve shows the observed survival. Note the flattening of the curve after four years, which shows that patients are apt to stay well if they pass this time. For method of deriving curve, see "An Improved Method for the Treatment of Cancer Statistics," by L. G. Jacobs, *RADIOLOGY*, October, 1936, **27**, pp. 468-473.

heavy course. (As a matter of fact, two courses were regularly advised, but not always accepted.) The obvious explanation for this observation, that large amounts of x-ray are needed for cure, is the only one which appears to bear critical analysis.

Looking at the series as a whole, we see that there is a fair salvage rate (Fig. 2) for a five-year period, about 35 per cent. Since the trend of the curve is flat, those who have survived over five years may be considered as probably cured, although of

resents a constant threat to life which will no doubt eventually materialize. Those surviving over four years and now living were by no means all "favorable" cases at the beginning of treatment. Two had extensive peritoneal metastasis, in one case with invasion of the bladder. Four more patients had, on beginning their course of radiation, definite recurrences after a previous operation. One patient, surviving two years and still in good condition, had only a biopsy done, as the tumor had already involved the surround-

TABLE IV²

No.	Age	Date Onset	Date Diagnosis	First Treat. Date	Second Treat. Date	Third Treat. Date	Fourth Treat. Date	Fifth Treat. Date	Date Death	Diagnosis Notes
256	36	12-?-26	5-?-27	5-?-27 S*	6-24-27 X*	9-27-27 X*	2-24-28 X*	9-21-28 X'	A and W	Gelatinous adenoca.
276	65	5-15-27	6-15-27	6-15-27 S	7-21-27 X*	12-?-27 X*			5-?-29	Cystic ca. c. metastases
504	38	3-?-28	5-?-28	5-1-28 S*	6-13-28 X*	9-21-28 X*	10-30-29 X*		A and W	Papillary ca. c. metastases
548	56	?-?-26	?-?-26	?-?-26 S*	8-?-28 S*	8-4-28 X*			A and W	Colloid ca. c. metastases
604	49	3-?-26	5-?-28	5-9-28 S*	11-2-28 X*	6-?-29 S*	9-17-29 X*		8-2-34	Cystic adenoca.
629	44	?-?-27	11-?-28	11-?-28 S*	12-10-28 X*	3-20-29 X*			6-26-29	Adenoca. (c. diabetes and myocarditis)
795	33	?	5-?-29	5-?-29 S*	7-2-29 X*	10-1-29 X*			12-17-29	Cystic ca. c. metastases
892	53	8-?-29	8-21-29	8-21-29 S*	10-4-29 X*	3-21-30 X*			11-11-30	Cystic ca.
1,230	72	?-?-25	?-?-26	?-?-28 S*	9-10-30 X*	4-22-32 X*			4-3-35	Ca. type not stated
1,340	37	?-?-29	9-?-30	9-?-30 S*	12-29-30 X*				A and W	Cystic papillary ca.
1,407	61	12-?-30	2-14-31	2-14-31 S*	3-11-31 X*	6-30-31 X*			1-2-32	Solid papillary ca. c. metas.
1,430	70	?	12-?-29	12-?-29 S*	3-30-31 X*				5-5-31	Ca. type not stated
1,505	58	9-?-30	4-30-31	4-30-31 S*	5-20-31 X*				11-2-31	Cystic ca. c. metastases
1,529	56	3-?-31	5-21-31	5-21-31 S*	6-4-31 X*	9-18-31 X*	1-29-32 X*	10-25-32 X*	2-?-33	Solid papillary adenoca.
1,588	43	?	6-18-31	6-18-31 S*	7-29-31 X*				A and W	Pseudomucinous cystic ca.
1,600	80	6-?-30	10-?-30	10-?-30 S*	8-5-31 X*				9-3-31	Ca. type not stated
1,634	24	6-?-31	6-6-31	6-6-31 S*	8-31-31 X*				11-25-35	Cystadenoca.
1,725	50	?-?-30	6-?-30	6-?-30 S*	10-28-31 X*				AcP	Cystadenoca.
1,828	49	12-?-30	10-15-31	10-15-31 S*	1-11-32 X*				9-16-33	Papillary cystadenoca.
1,995	40	many yrs.	3-1-32	3-1-32 S*	4-19-32 X*				A and W	Solid ca.
2,107	45	?-?-30	?	6-20-32 X*					4-22-33	Cystadenoca.; ulcerated through umbilicus
2,110	41	12-?-30	1-?-31	1-?-31 S	6-22-32 X'				6-30-32	Cystic ca. (ruptured into bowel)
2,161	30	1-2-30	6-2-30	1-2-30 S*	6-2-30 S*	8-1-32 X*	2-27-33 X*	12-2-33 X*	AcP	Cystic ca.; ascites
2,173	47	5-?-31	6-?-32	7-?-32 S*	8-10-32 X*				A and W	Pseudomucinous cystic ca.
2,223	57	?-?-31	7-20-32	7-21-32 S*	9-14-32 X*	2-20-33 X*			AcP	Degenerating ca., type not stated
2,265	68	?-?-10	?-?-10	?-?-10 S*	?-?-27 S*	10-12-32 S*	10-25-32 S*	11-5-32 X*	A and W	Cystic ca.
2,331	62	9-?-30	10-?-30	10-?-30 S*	10-24-32 X*	3-21-33 X*			7-30-34	Cystic ca.; cardiac decompensation
2,367	59	5-?-32	8-?-32	8-?-32 S*	12-28-32 X'	12-30-32 S			1-9-33	Cystic ca.; patient too ill to complete x-ray course
2,376	43	3-?-32	11-?-32	11-?-32 S*	1-4-33 X*				3-22-33	Adenoca.
2,380	30	6-?-32	11-?-32	7-?-32 S*	11-?-32 S*	1-6-33 X*	3-27-33 X*	6-20-33 X*	9-4-33	Adenoca.
2,384	73	12-?-32	1-?-33	1-?-33 X*					5-10-35	Ca. type not stated
2,561	76	3-30-33	4-6-33	4-6-33 S*	5-12-33 X*				2-20-34	Cystic ca. c. metastases
2,574	51	10-?-32	5-6-33	5-6-33 S*	5-18-33 X*				A and W	Papillary cystic ca.; had also ca. breast c. S*, X*

No.	Age	Date Onset	Diagnosis	First Treat.	Second Treat.	Third Treat.	Fourth Treat.	Fifth Treat.	Date	Death	Diagnosis Notes
2,600	58	3-2-33	5-1-33	5-1-33 S*	6-6-33 X*	1-17-34 X*	6-15-33 X*		7-28-34	A and W	Cystic ca. Grade IV
2,619	22	4-2-30	7-8-30	7-6-30 S'	7-8-30 S*	5-18-33 S'			7-9-33		Cystic ca.
2,639	58	2-2-33	6-9-33	6-9-33 S*	6-24-33 X*	7-11-33 R			8-21-33		Nodular cystic ca. c. metas.
2,645	62	1-2-33	6-23-33	6-23-33 S*	7-6-33 X*						Cystic ca. c. metastases; peritonitis secondary to treatment ?
2,885	53	9-2-33	9-2-33	11-14-33 X'					11-21-33		Cystic ca.
2,918	56	2-2-32	2-2-32	2-2-32 S'	12-6-33 X*	5-11-34 X*			2-25-35		Cystadenoc. c. metastases
2,988	26	12-2-34	1-2-34	?	1-9-34 X*				4-2-34		Solid ca. c. metastases
3,021	55	9-2-33	9-11-33	9-11-33 S'	9-2-33 X*	1-29-34 X*	2-13-35 X*		A and W		Ca. type not stated
3,039	73	2-2-14	?	2-8-34 X*					3-6-34		Ca. clinical diag., no post.
3,133	59	11-2-33	1-26-34	1-26-34 S'	4-5-34 X*				11-13-34		Ca. type not stated
3,157	44	10-2-34	4-2-34	4-17-34 X*					11-13-34		Ca. clinical diag., no post.
3,159	55	1-2-34	4-2-34	4-11-34 X*					9-22-34		Solid ca.
3,190	61	1-2-34	?	5-3-34 X*					6-3-34		Ca. (cells in tap fluid)
3,203	54	4-1-34	5-2-34	5-9-34 X*					2-2-35		Cystic ca. with bone metas.
3,239	20	1-2-34	5-2-34	5-8-34 S'	6-1-34 X*				A and W		Cystadenoc.
3,284	60	6-2-33	2-23-34	2-23-34 S'	6-29-34 X*				11-25-34		Cystic ca.; bronchopneumonia
3,270	67	1-2-33	6-8-34	6-8-34 S'	6-19-34 X*				3-4-35		Serous cystadenoc.
3,349	38	8-2-33	7-2-34	7-2-34 S'	8-6-34 X'				8-29-34		Ca. type not stated; patient too ill to finish course
3,409	42	2-2-29	2-2-30	2-2-30 S'	9-4-34 S*	9-15-34 X*	4-4-35 S'	5-8-35 X*	A and W		Cystic ca.; severe arthritis
413	?	Sev. yrs.	12-12-27	12-12-27 S'	2-1-28 X*				5-22-28		Cystic ca.
881	58	9-2-28	5-2-29	5-2-29 S	9-23-29 X*				12-27-29		Ca. c. peritoneal metastases
1,052	39	12-2-28	1-25-29	1-25-29 S'	3-31-30 X*	8-8-30 X*			10-2-30		Cystadenoc. c. metastases
1,171	60	6-2-29	1-2-30	1-2-30 S	7-11-30 X*				10-14-30		Solid ca.
1,188	51	4-29-30	6-12-30	6-12-30 S*	7-30-30 X*				10-24-30		Solid ca.
1,149	64	12-2-30	?	12-2-30 R?	3-30-31 X'				4-15-31		Ca. c. peritoneal metastases
1,925	48	9-2-27	12-2-27	12-2-27 S'	3-10-32 X*				4-19-32		Cystic ca.
1,512	23	1-2-27	10-2-29	10-2-29 S'	8-2-30 S*	9-2-30 X	5-19-30 S	5-25-31 X*	5-25-32		Spindle-cell sarcoma
3,085	26	8-2-33	8-2-33	8-2-33 S'	3-7-34 X*				5-12-34		Fibrosarcoma c. cystic mass
2,487	47	9-2-32	3-21-33	3-21-33 S'	3-30-30 X*				A and W		Granulosa-cell tumor
1,822	46	5-2-31	9-18-31	9-18-31 S'	1-8-32 X*	3-30-32 X*			8-18-32		Benign adenoma (?)
1,954	50	2-2-29	2-2-29	2-2-29 S'	3-29-32 X*	3-4-33 X*			AcP		Benign cyst c. transplants

² Key to Symbols in Table IV: S*—biopsy only; S'—excision; S''—tapping only; S—surgical procedure, type unknown; X*—large dose x-ray; X''—medium dose x-ray; X'—small dose x-ray; X—unknown dose x-ray; R—radium (given elsewhere, so dose unknown); A and W—alive and well; AcP—alive with persistence or recurrence; c.—with.

ing region so extensively as to render removal impossible.

Since the normally expected death incidence in a group such as this is rather high, about 13 per cent in five years, the actual cure rate may readily be as high as 35 per cent. The standard deviation of the cure rate is about 5 per cent, so that it is within the bounds of possibility that the true cure rate will fall between 20 per cent and 50 per cent, but hardly outside these values. Observe that we here mean the rate of those permanently cured, not the five-year cure rate.

Evaluation of the degree of palliation secured in those patients who died is not possible, but one can safely say that it is a very real amount. Several patients had from a few months to several years of normal or almost normal life before a recurrence finally led to invalidism and death; and even in cases not symptom-free vari-

ous degrees of improvement were noted, as a rule. Only a few advanced cases failed to receive any benefit from their treatment.

In conclusion, radiation will produce enough cures in carcinoma of the ovary, even advanced, to make it a decidedly justifiable procedure. The amount of radiation must be adequate, however, and repeated courses are probably advisable. The figures quoted suggest that there may be a slightly higher cure rate in this sensitive tumor than in some of the more resistant gynecological tumors.

Acknowledgments: The clinical direction of these patients has been in the hands of the Department of Gynecology and Obstetrics, Prof. J. C. Litzenberg, head. We wish also gratefully to note the aid and advice of Dr. Litzenberg in the preparation of this paper.

THE TREATMENT OF HYPOTONIC MEGACOLON BY ADMINISTRATION OF PANCREATIC TISSUE EXTRACT

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SINCE Hirschsprung described the congenital megacolon in 1886, much has been written concerning treatment, both surgically and by the use of various drugs for stimulating the parasympathetics and producing peristalsis.

Megacolon may be classified as congenital and acquired. The congenital type, as described by Hirschsprung, is associated with hypertrophy and the thickening of all the layers of the colon wall. The acquired type is subdivided into those produced by mechanical obstruction and by idiopathic dilatation. It is this latter group with which we wish to deal.

Sheldon and Kern (1) attempted the use of parathormone, but their conclusions do not appear to be lasting in effect. It was their opinion that the patients might have a low grade chronic parathyroid deficiency. Our studies have not borne this out.

Bonar (2) believes the etiology of idiopathic megacolon to be neuromuscular, due to failure of the pelvi-rectal flexure to relax with oncoming peristaltic waves. By means of rectal injections of a saturated solution of magnesium sulphate, he found the action to be local, apparently due to neuromuscular irritation and relaxation of the musculature.

Craven and McCrea (3) studied the effect of tissue extract and other vascular depressor substances, and Craven (4), in 1934, reported two cases of megacolon in children treated by means of pancreatic tissue extract. Her theory was that pancreatic extract is parasympathetic in action. In her work on direct observation of the intestines of the guinea pig, also on isolated strips of intestine, there was immediate contraction. After this contraction has been maintained for a short time, it becomes rhythmical. Some of the other

parasympathetic drugs—atropine, thyroxin, parathormone, and magnesium sulphate—produced contraction but did not increase the rhythm. This probably explains why a short time after the drug is discontinued, the intestine fails to respond.

PREPARATION USED

The extract used is that of Sharp and Dohme, No. 568, as prepared in collaboration with Dr. Joseph Wolfe (5). It is a product of pancreatic tissue extracted with acid alcohol. After precipitation of insulin, the precipitate is purified and physiologically standardized by its ability to neutralize the pressor action of epinephrine on anesthetized dogs. The solution is then adjusted to contain ten units per c.c. The unit value is defined from the epinephrine neutralizing action: one unit equals one gamma of epinephrine. Therefore, 1 c.c. will neutralize 0.01 mg. of epinephrine.

DOSAGE

The dosage used in the treatment of the atonic colon varies from 1 to 5 c.c., depending on the severity of the condition and the response of the patient. The usual daily dose is 3 c.c., which seems to give the maximal effect. Wolfe states, "We have administered more than 5,000 injections and there has never been any untoward local or general reaction, save a slight burning at the time of injection. No chills, fever, or other systemic reactions have been noted."

CASE REPORTS

Case 1. A married female, aged 28, was admitted March 17, 1934, with a history of increasing constipation of seven years' duration. Following operation for appendicitis, she noticed a gradually increasing

constipation which had become so severe that she resorted to daily enemas during the last year. The stools had been mixed

bowel movements for three days, then normal stools. The bowels have been regular until the present time, 1937.



Fig. 1. Case 2. Dilated colon. No former treatment.

with considerable mucus, and occasionally small amounts of blood. The diet had been balanced and water intake adequate.

Physical Examination.—Entirely negative. A proctoscopic examination showed normal mucosa. The lumen was quite large and dilated.

Laboratory Studies.—Blood and urine examinations were negative. Stool examination disclosed nothing unusual. A barium enema showed the colon to be large and atonic with loss of haustral markings. The basal metabolic rate was -18 per cent.

Treatment.—Tissue extract was given: 1 c.c. the first day; 2 c.c. the second, and 3 c.c. on the third day and daily, thereafter, for ten days.

Clinical Course.—Normal bowel movements were obtained after the second injection and continued to improve. Pregnancy, with normal delivery, occurred on Jan. 18, 1935. Bowel movements were still normal until the following April, one year after beginning treatment, when constipation recurred. The course of tissue extract was repeated. There were no



Fig. 2. Case 2. The colon after tissue extract. The muscle tone has been greatly improved but is still moderately dilated.

Case 2. A white male, aged 3, with a history of constipation since birth, was admitted May 25, 1936. The stools though infrequent had been large and quite hard. The patient had been otherwise normal. Constipation had been worse during the past year, with as many as ten days elapsing between stools.

Physical Examination.—The abdomen was markedly distended and fecal masses could be easily palpated.

Laboratory Studies.—The blood, urine, and stools were negative. A barium enema disclosed a large atonic colon, probably congenital in origin (Fig. 1).

Clinical Course.—Pancreatic tissue extract was administered three times daily in 0.5 c.c. doses from May 27 to May 30. The distention was relieved and there was irregular spontaneous bowel movement. Roentgen-ray examination of the colon showed definite improvement in muscle tone (Fig. 2).

Case 3. A white male, aged 64, was admitted to the hospital on March 9, 1936, with a history of dull epigastric pain of nine months' duration, the pain coming on regularly 30 minutes after eating. Oc-

casionally, he was nauseated and would vomit. Vomitus contained blood on several occasions. He had lost 40 pounds in the past six months. This was accompanied by a very obstinate constipation.



Fig. 3.

Fig. 3. Case 3. Dilated colon. No former treatment.



Fig. 4.

Fig. 4. Case 3. After tissue extract, showing rather marked improvement in muscle tone but still a certain degree of hypotonicity.

Physical Examination.—The abdomen was greatly distended, but no masses could be made out and there was no tenderness.

Laboratory Studies.—The blood showed considerable secondary anemia. The stools were positive for blood, the benzidine and guaiac tests being 4+. Roentgen-ray examination disclosed a large carcinoma of the lower third of the esophagus. The esophageal hiatus was wide, and the fundus of the stomach herniated through it. The colon was large and atonic, with almost complete loss of muscle tone (Fig. 3).

Clinical Course.—Injections of intramuscular tissue extract were given twice daily in 0.5 c.c. doses for three days. There was a most striking improvement in muscle tone, accompanied by normal bowel movements (Fig. 4).

The patient died of malignancy a few months later.

Case 4. A white male, aged 9, was admitted Feb. 22, 1933, complaining of severe constipation since birth. He usually went two to four days without a stool and had been given cathartics since birth. His

abdomen had been distended, apparently due to impacted fecal material.

Physical Examination.—The patient's abdomen was very distended and a large mass could be easily palpated in the lower mid-portion. The veins over the abdominal wall were distended. Proctoscopic examination revealed a normal mucous membrane.

Laboratory Studies.—The blood, urine, and stool examinations showed no pathology. A barium enema disclosed a large and atonic colon (Fig. 5).

Diagnosis.—Congenital megacolon.

Clinical Course.—Intramuscular injections of tissue extract in 0.5 c.c. doses were given three times daily from March 2 to March 11, and in 1 c.c. doses three times daily from March 12 to March 24. During this period, the patient began to improve and to have from one to four stools

daily. He continued to improve for one year, when constipation again appeared. A barium enema at this time showed marked improvement in muscle tone, but a constriction was found at the

atonic colon, which had the appearance of Hirschsprung's disease.

Clinical Course.—Intramuscular injections of pancreatic tissue extract were given in 1 c.c. doses, three times daily.



Fig. 5. Case 4. Dilated colon. No former treatment.

recto-sigmoid junction. This constriction was thought to be congenital or due to a band of adhesions. Because of the mechanical obstruction, no more tissue extract was given (Fig. 6).

Case 5. A white male, aged 6, was brought into the out-patient clinic on June 27, 1933, with a history of occasional vomiting since birth. The vomiting, when it occurred, was projectile in character. The abdomen had gradually increased in size during the first week of life, until at the present time, it was greatly distended. His food was carefully watched, and he received a well balanced diet, but it was difficult to get him to eat it. The distention was accompanied by increasing constipation, which was relieved at frequent intervals by saline purges.

Physical Examination.—The patient was markedly emaciated. His abdomen was very distended and the veins of the abdominal wall were quite dilated.

Laboratory Studies.—The blood, urine, and stool examinations were entirely negative. Roentgen-ray examination of the colon showed a very large and completely



Fig. 6. Case 4. Colon after series of tissue extract, showing the congenital mechanical obstruction.

This was begun on June 28, 1933, and continued at intervals until Sept. 15, 1933. Marked improvement was noted for the first six months, but at the end of this time, there was a recurrence of the constipation. This, however, was not as severe as before.

Case 6. A white female, unmarried, age 19, was admitted to the hospital on Nov. 5, 1934, with a history of constipation over a period of four years. At times, she would go for a week without a bowel movement, and then resort to an enema. At one time, she was taking magnesium sulphate and calomel daily, and for the past 18 months had taken an enema every night. Eserine and thyroid extract had been tried, but did not produce beneficial results.

Physical Examination.—The general physical examination did not reveal any pathology. A proctoscopic examination showed a dilated colon, having very little tone. However, the mucous membrane was normal.

Laboratory Studies.—The blood, urine, and stool examinations were normal. Ba-

sal metabolic rate was -18 per cent. A barium enema showed the colon to be atonic and no haustrations were present.

Clinical Course.—Pancreatic tissue extract was given by intramuscular injection in doses of 1 c.c. the first day; 2 c.c. the second day, and 3 c.c. daily thereafter for ten days. On the third day, the patient had two normal bowel movements and continued to have from one to two bowel movements a day. When last heard from, two years after discharge, the bowels were entirely regular.

Case 7. A white girl, aged 13, was admitted on Feb. 5, 1936, with a history of alternating diarrhea and constipation since January, 1935. Her condition was diagnosed as Hirschsprung's disease in August, 1935, and was treated with laxatives. The treatment was not successful and the patient still has constipation with the occasional passage of watery or mushy stools. As a rule, her bowels moved only once in four to five days.

Physical Examination.—The general examination showed no evidence of disease. A proctoscopic examination showed an enormously dilated colon, measuring fully six inches in diameter. The proctoscopic findings were confirmed by barium enema, which showed a dilated and atonic colon.

Laboratory Studies.—The urine and stool examinations were normal.

Clinical Course.—Intramuscular injections of pancreatic tissue extract were given, 1 c.c. three times daily for ten days. For one week before beginning the injections of tissue extract, a daily enema was required. On the day after starting the injections of tissue extract, there was a normal bowel movement and she continued to have one to three normal stools daily until discharged one month later. A barium enema just before discharge showed the colon to be smaller and more normal in tone.

Case 8. A white female, aged 26, was admitted on May 22, 1936, with a history of marked constipation for the past ten years. Her bowel movements were very infrequent and she often went as long as

seven to 10 days between stools. She had taken all the usual laxatives, but the constipation became worse in spite of such measures.

Physical Examination.—The physical examination showed no evidence of disease. The proctoscopic examination showed a normal mucosa, but dilated atonic walls.

Laboratory Studies.—The blood, urine, and stool examinations were normal. A barium enema disclosed a large sluggish colon with thickened walls.

Clinical Course.—Intramuscular injections of pancreatic tissue extract were administered in doses of 1 c.c. the first day, 2 c.c. the second day, and 3 c.c. daily thereafter for four days. On the second day, the patient had two normal bowel movements and continued to have from one to two daily stools. No other treatment has been considered necessary. When last heard from, the patient was having a bowel movement every day and on many days, she would have two movements.

CONCLUSIONS

Pancreatic tissue extract has been found of definite value in the treatment of the hypotonic colon and Hirschsprung's disease. Its action is that of epinephrine antagonist, stimulating the parasympathetics and producing a more normal rhythm of the intestine. The extract is not a specific in that some of our cases did not respond as well as others. Some were benefited only temporarily, while others seemed to obtain complete relief.

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SOME LAWSUITS I HAVE MET AND SOME OF THE LESSONS TO BE LEARNED FROM THEM¹

(Second Series, First Installment)

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., Chicago

A LUNG CASE

A MOST egregiously grotesque and fraudulent claim in a case in which I was recently called, wherein one of the big merchandising firms was being sued for one hundred thousand dollars, will, I am certain, be of decided interest to radiologists and pneumonologists.

The plaintiff in the case alleged that a refrigerator purchased from the defendant

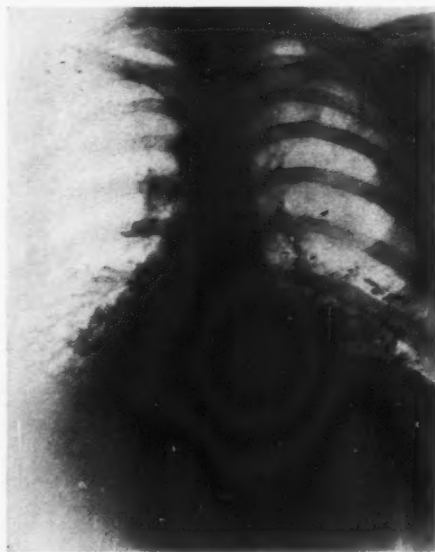


Fig. 1.

leaked gas (CS_2) and that he had been poisoned by inhaling this gas during his sleep. As the result of this poisoning he said he suffered from a chronic lung inflammation, great weakness, inability to do any sort of work, etc., and was therefore com-

pletely disabled, weakened, crippled, maimed, lamed, injured, mutilated, incapacitated, disqualified, impaired, etc., *ad nauseum*.

Stereoroentgenograms of the plaintiff's thorax, made at the suggestion of one of the physicians for the defendant's attorneys, did not appear like what he thought the plaintiff claimed ailed him. The films were, therefore, brought to me for examination and report (see Fig. 1). I reported in part as follows: "The films are those of an adult human, probably male. They show the heart to be of normal size, contour, and position, the aorta to be of normal size and contour, the mediastinum to be clear, and the trachea to follow its normal course without deviation or distortion.

"The lungs show normal apices. The parenchyma and lung-fields are normal in the upper lobe of the left lung and in the upper and middle lobes of the right lung. In these portions of both lungs, there is no indication of any acute or chronic disease. There is no fibrosis, cavitation, bronchial thickening, or other change.

"In the lower portion of lower lobes of both right and left lungs are numerous small shadows which are produced by some substance of greater density than the surrounding tissue, and from the character of these shadows, their form, distribution, density, and location, it is quite evident that they were produced by some heavy substance which was recently introduced into these lungs. Some such substance as iodized oil, which, you of course know, is frequently used for diagnostic purposes, has unquestionably been introduced into this man's lungs and shows in the roentgenograms as above described.

"The bronchial shadows except where involved in the iodized oil region are normal. The hilar shadows are practically

¹ The Editor desires to state that much of the matter herein has, because quotations of court proceedings to be printed in form as received, without normal punctuation or phrasing.

normal for a man of 35 to 40 years. The pleura shows no departure from normal. There is no thickening, adhesion, or indication of fluid. The diaphragm is apparently normal. The arches are normal, as are also the cardiophrenic and costophrenic angles. There is no indication of herniation or eventration.

"General Summary of Roentgen Findings.—There are no roentgen indications of lung pathology or disease. Bronchitis, chronic inflammation, or acute inflammation are not shown. Except for the presence of the shadows which I am certain are produced by iodized oil in the lower lobes of the lungs shown in these films, the lungs portrayed are as near normal as one will find in a day's search, in a man of his age."

Because I was so sure of my diagnosis, two other roentgenologists were shown the films, and both of these agreeing with my findings, we were instructed to be prepared to go on the witness stand. Our theory was that the rascally plaintiff was malingering from the start and was, with the aid of a physician (I am too charitable to call him crooked, but I can think it), trying to show that he had some pulmonic disease. When called upon to have the x-ray examination of his thorax, they had the iodized oil injected, which, of course, caused the production of the shadows, which they hoped would be diagnosed as pathology. Their failure to put their fraud over was in a large measure because the films were made with the patient (plaintiff) standing erect, so that the droplets gravitated to the most dependent part and showed only in the lower portions of the lower lobes, whereas we know that the shadows of the condition claimed in the bill of particulars of the case would be in and near to the large bronchi.

A conference of the expert witnesses who expected to appear in the trial of this case, consisted of two toxicologists, an internist, two industrial medical specialists, three radiologists, two neurologists, and the physician who first saw the plaintiff as a patient. These eleven physicians were unanimous, and so assured the attor-

neys that the man was malingering. We were informed that this individual looked like a walking cadaver, that he had looked that way for the last 15 years and that he would certainly elicit the sympathy of the jury. However, we were further informed by the attorney in charge of the case, that he had motion pictures of the plaintiff climbing the stairs of the elevated railroad, shovelling coal into his coal bin, walking briskly on the street, etc., and all of us were chuckling over how this rascal and his trickster attorneys were to be discomfited. The case was well and completely planned and worked out and appeared as near a sure thing as one might hope for.

But with all this, with every assurance that they would win, the defendants paid the plaintiff \$15,000, just before the calling of the suit for trial, because they feared that they could not afford to have their name and that of their refrigerator appear in the public press. That may be, and possibly is, good business; but to all the eleven medical men involved in the case it was at least *contra bonos mores ad nauseam*.

"NEGLIGENCE OR WANT OF SKILL IN ADMINISTERING X-RAY TREATMENT, EVEN IF ESTABLISHED, IS NOT ENOUGH TO ENTITLE PLAINTIFF TO RECOVER"

The foregoing statement is quoted from the Supreme Court decision in a very important suit twice tried in Arizona.²

A woman aged 38, suffering from an inoperable sarcoma in the inguinal region, applied to a physician for treatment. The physician, after examining the patient, decided that the condition was inoperable, recommended x-ray therapy, and referred her to the defendant physician for such x-ray treatment as he deemed proper. The first and only application of the roentgen rays resulted in an alleged dermatitis. The patient died some four and one-half months later and the administratrix of the estate brought suit against the radiologist, charg-

² Butler vs. Rule, 242 Pac. R., 436.

ing the usual long list of allegations and asking damages in the amount of \$50,000.

A trial before a jury in the Superior Court of Pima County, Arizona, resulted in a verdict for the plaintiff with judgment for \$1,000 damages. Defendant's attorneys moved for a new trial, which was denied. The case was then appealed to the Supreme Court of that State, alleging numerous errors. Jan. 7, 1926, the Supreme Court rendered decision in the case, from which we quote in part as follows:

"..... It is the contention of the plaintiff that her intestate's death was caused or hastened by the treatment, and that such treatment, was negligent and unskillfully administered.

"The defendant's contention is that intestate's death resulted from the cancer solely.

"The plaintiff as a part of her case, called Dr. Butler, for cross-examination and had him explain how the x-ray treatment was administered. His statement was, in effect, as follows; The patient was placed on the x-ray operating table. The place to be treated was bared, and the parts of the body not to be exposed to the x-ray were protected by a cover of lead-impregnated rubber. The aperture was a parallelogram of sufficient size to expose the large growth and leave a margin for the smaller growths. The x-ray tube was of the Coolidge type; it was a standard tube. The voltage used was between 85,000 and 90,000 volts. The tube was adjusted to moderately hard. The target or focal spot was placed 15 inches from the skin or surface of the growth. The strength of the current applied was 5 milliamperes. The filters used were leather and aluminum and were standard for a 15-inch distance between the focal spot of the tube and the skin. The treatment lasted 30 minutes.

"The only expert testimony upon the question as to whether the above described treatment was proper or not was that of the defendant and Dr. R. J. Callender. Dr. Butler said that the treatment he gave, and as outlined, was a proper one; and Dr. Callender, testifying as an x-ray expert, said such treatment was proper. He added that he would expect such a treatment to produce an erythema or a slight flush of the skin, but no more.

"According to these experts, defendant was not guilty of negligence or want of skill. In giving the treatment, he had exercised the care and skill usual among physicians and surgeons in good standing under similar circumstances—the standard to judge him by in the use of the x-ray as a remedial agent. If the operation

was performed as detailed by the defendant, he fully met his legal obligation to his patient (*Henslin vs. Wheaton*, 91 Minn., 219; 97 N. W., 882; 64 L.R.A., 126; 103 Am. St. Rep., 504; 1 Ann. Cas., 19), and every charge of negligence or lack of skill was refuted.

"However, if there was evidence as to the manner in which defendant administered the treatment in conflict with his testimony, and tending to show that in some essential the treatment was not given as defendant stated, the expert testimony to that extent would fail, and a question of fact for the jury arise. The value of an answer to a hypothetical question may be destroyed, if the facts or some of the facts upon which it is based are not conceded or proved as a part of the case. While defendant stated the distance from the target to the skin by measurement to be 15 inches, witness Margaret Robson, who was the only person present aside from defendant during the treatment, testified that such distance was 10 or 12 inches. It is argued by defendant that his testimony does not create a conflict, because defendant's figures were the measured distance, whereas Robson was only estimating the inches between the given points. Defendant's words were: 'In setting my apparatus my distance at 15 inches, I measured as closely as possible to the estimated center of the growth, so that the distance from the target to the skin was 15 inches, and used the current which I estimated would have its greatest effect in the center of the growth. I measured to the highest part nearest the target. The skin distance from the top of the cancerous condition to the target was 15 inches. That was proper treatment; I should do the same thing again if the same conditions presented themselves.'

"A positive statement of the distance, arrived at by actual measurement, certainly should be taken against an estimate or guess and, if the question involved only which of the two methods was more accurate, we would be willing to agree with the defendant that no conflict was created. But the question also involves the veracity of the witness. The jury have concluded defendant did not measure the distance at all, and that his statement that he did was not sure. Where there is a conflict in the evidence, the weight and credibility to be given the witness is always a question for the jury. If the jury believed Robson's testimony, the length of the treatment should have been limited, according to defendant's own testimony, to between 15 and 14 minutes. He also said: 'It would not have been a proper treatment to have applied the treatment to Mrs. Holloway for 30 minutes at a 10-inch distance. I estimated that the 15-inch distance should be 30 minutes ...'

"If the target was only 10 or 12 inches from the skin, under the expert testimony, the treatment was improper, and the defendant, in its administration, failed to use the care and skill usually exercised by the members of his profession similarly situated. So we conclude that there was sufficient evidence or want of skill to take the case to the jury.

"The negligence or want of skill in administering the x-ray treatment, even if established, is not enough to entitle the plaintiff to recover. [Italics are mine.] She must go further and show that the injury suffered in such treatment caused the death of her intestate or hastened such death. The defendant contends that all the evidence was to the effect that intestate died from cancer. It is true that two physicians testifying as experts said that in their judgment Mrs. Holloway died of sarcoma or cancer, and no one testified that the x-ray burn caused her death, or hastened it, or contributed to it. Notwithstanding, we think the physical facts justified the court in submitting to the jury the question as to whether the burn received in the treatment caused or contributed to the death of plaintiff's intestate. The swelling of her stomach and leg, the blisters thereon, her inability to rest, loss of sleep, and the continuous pain and suffering, all came immediately after the burn, and doubtless were caused thereby. Naturally, it would seem their effect would be to lower her vitality and to hasten her death. The death certificate introduced by defendant gave the cause of death as 'carcinomatous pelvic organs and ulcer.' There was but one ulcer on the body of the deceased, and that was the x-ray burn which the certificate shows caused or contributed to the death of the intestate.

"Error is charged in the court's refusing to permit certain of defendant's expert witnesses to answer hypothetical questions. These witnesses had been intestate's physicians, and as such had obtained knowledge of her condition and ailments. Any information that came to them while acting in that capacity was confidential and privileged. However, the rule seems to be that a physician who has attended a party is not disqualified to testify as an expert concerning such party's ailment, when he can disregard what he has learned in communicating with and examining such patient, and make his answers solely upon the facts as related in hypothetical questions. *Triangle Lbr. Co. vs. Acree*, 112 Ark., 534; 166 S. W., 958; *Ann. Cas.*, 1916B, 773; *Crago vs. City of Cedar Rapids*, 123 Iowa, 48; 98 N. W., 354; 40 Cyc., 2388. We think from what happened the learned trial court recognized this rule. The defendant had asked one of such witnesses hypothetical questions, and before he had answered he had been admonished by plaintiff's

attorney several times that his answers should be 'from the history as detailed by Dr. Butler alone.' On cross-examination, this witness was asked if his testimony was based on what he had heard Dr. Butler say while testifying and he answered: 'Well, in conjunction with my opinion also, . . . What I saw of her, yes.' The next three witnesses, who had professionally attended intestate, were allowed to answer without objection, preliminary questions as to being present and hearing Dr. Butler detail the history of intestate's case. But when it was made to appear they had examined and advised intestate as to her case, plaintiff objected to their testifying as experts, 'unless it is shown by the witness that he can disassociate any idea he may have received from an examination and advice in regard to this burn and the sarcoma.' The court ruled: 'Upon the present showing, the objection is sustained.' In view of the developments in connection with the first of such witnesses, we cannot say the court erred in requiring the defendant to qualify his witness before proceeding to question him as an expert. While perhaps this is not in accord with the announced rule (*Eddington vs. Aetna Life Ins. Co.*, 77 N. Y., 564), we think that if the defendant had felt certain his witnesses could qualify he would have asked then the necessary questions. After all, the question was whether the witnesses were qualified or not, and we can see no particular advantage or disadvantage in requiring the plaintiff to qualify his experts in that respect. At all events, we would not disturb the discretion of the court in that regard.

"The plaintiff called Dr. Callender as a witness, and asked him this question: 'Now Doctor, in the use of an x-ray machine, in administering x-ray treatments, called deep therapy the highest degree of care should be exercised, . . . should it not?' The court permitted the witness to answer the question, over an objection to the effect that the degree of care in such cases was a question of law, the court stating that he thought it a question of fact, and the witness answered: 'He ought to exercise all the care he can.' Consistent with the above ruling was the following instruction to the jury: 'However, if you should believe from a preponderance of the evidence that the reasonable care and skill required of, or usually exercised by, physicians in good standing who are operating x-ray machines is a high degree of care, then the defendant in this case would be held to a high degree of care.'

"Both of the above rulings are assigned as error. The degree or measure of care to be exercised by a physician or surgeon in the practice of his profession is very definitely and well settled. You will find it stated over and over in the decisions and in the text-books, and in all

it is practically the same. The statement of the rule is made by the Supreme Court of New York in *MacKenzie vs. Carman*, 103 App. Div. 246, 92 N.Y.S., 1063, has been extensively quoted and approved and we use it as a fair expression of the law. It is as follows: 'The law thus requires a surgeon to possess the skill and learning which is possessed by the average member of the medical profession in good standing, and to apply that skill and learning with ordinary and reasonable care. He is not liable for a mere error of judgment provided he does what he thinks is best after a careful examination. He does not guarantee a good result, but he promises by implication that he will use the skill and learning of the average physician, to exercise reasonable care, and to exert his best judgment in the effort to bring about the best results.'

"See also. *Loudon vs. Scott*, 58 Mont., 645; 194 Pac., 488; 12 A.L.R., 1487. The degree of care to be exercised is therefore a question of law. Whether defendant's act meets the standard of care required is a question of fact.

"Expert witnesses may well be asked to explain the customary and correct methods employed by medical men in good standing in administering x-ray treatments, for the purpose of guiding the jury in determining whether in the given case the defendant exercised ordinary care. *Samuels vs. Willis*, 133 Ky., 459; 118 S.W., 339; 19 Ann. Cas., 188. Such customary and correct methods so detailed could have no other purpose than to show the jury how the profession acts when exercising ordinary care and caution, and to establish for the jury's guidance that standard or degree of care to be employed by them in arriving at their verdict. Now, if the witness may be permitted to state that the degree of care in such a case should be of the 'highest,' it would be giving another standard of duty, and if the jury should be of the opinion that the method used, although customarily and ordinarily used by the profession, was not the best, it would so decide. In other words, there would be no standard.

"There was no evidence in the record upon which to base the instruction, unless it be the answer to the improper question to the effect that the x-ray operator 'ought to exercise all the care he can.' The degree of care of 'a physician in good standing, operating x-ray machines,' is the same as physicians in general practice. This has been numerously decided. *Hayes vs. Lufkin*, 147; Minn., 225; 179 N.W., 1007; *Hamilton vs. Harris*, 223 S.W., 533; *Sweeney vs. Erving*, 35 App. D.C., 57; 43 L.R.A.(N.S.), 734; *Runyan vs. Goodrum*, 147 Ark., 481; 228 S.W., 397; 13 A.L.R., 1403; *Street vs. Hodgson*, 139 Md., 137; 115 Atl., 27; *Antowill vs. Fried-*

man, 197 App.Div., 230; 188 N.Y.S., 777. In *Stemons vs. Turner*, 274 Pa., 227; 117 Atl., 922; 26 A.L.R., 727, the court, after stating the rule that a physician or surgeon 'is only required to exercise such reasonable skill and diligence as is ordinarily exercised in his profession,' said: '... The trial judge announced an entirely different standard by instructing the jury... that it was the duty of defendant to use a high degree of care, whereas he was only required to use the ordinary care exercised under like circumstances, and in a higher degree of care only when compared with that called for in less important matters.'

"In the case of *Wilk vs. Clark*, 188 Mich., 478; 154 N.W., 561, the court gave the following instructions: 'The physician is not required to possess or exercise the highest degree of care and skill known to the profession in order to relieve him from liability,' and in *Hales vs. Rained*, 146 Mo. App., 232; 130 S.W., 425, the court instructed as follows: 'That the defendant (physician) was not bound to exercise extraordinary diligence or care in treating the plaintiff, but only reasonable care.' In this last case it was said: 'We gather from the authorities that the correct rule is that a physician and surgeon when employed in his professional capacity is required to exercise that degree of knowledge and skill and care which physicians and surgeons practising in similar localities ordinarily possess. In other words, a physician is held to that care and skill which was exercised generally by physicians of ordinary care and skill in his and similar communities. The physician is not chargeable with negligence for failure to use his best skill and ability if he used the care and skill which is exercised generally by physicians of ordinary care and skill in similar communities' (citing cases).

"The instruction, beside being abstract, announced an incorrect rule of law.

"The several other assignments of error we do not discuss, either because we are satisfied there is nothing to them, or because it is very improbable that they will arise in a retrial of the case.

"The judgment is reversed, and the case remanded with direction that defendant be granted a new trial.

"*Ross, C. J., McAllister, C. J., and Lockwood, J., concur.*"

At the second trial of this case, a verdict and judgment were again given to the plaintiff. The case was again appealed and the Supreme Court of Arizona reversed the judgment and remanded it, with instructions that it be dismissed. The same Su-

preme Court Justice wrote both Supreme Court decisions and the same other justices concurred. The final decision³ is so important to us as radiologists that I quote it in full.

"Ross, C. J. After the decision reported as *Butler vs. Rule*, 242 Pac., 436, this action was tried to a jury for the second time, again resulting in verdict for the plaintiff, and is now before us on assignments that present several questions, only one of which we need to consider. That question is whether the court erred in not granting defendant's request for an instructed verdict on the ground that there was no evidence to support a verdict.

"In our former opinion the facts are recited quite fully and will not be again stated except to show any changes or differences. The evidence is practically the same on the question of negligence, and our ruling thereon must be the same.

"From the present record, however, we are satisfied it is not shown that Mrs. Holloway's death was caused by the x-ray burn, and whether such burn hastened her death, is left to conjecture and doubt. That Mrs. Holloway was afflicted with sarcoma, and had been for 11 months before consulting defendant, that when she did consult him the disease was too far advanced for the surgeon's knife, and that the only hope of relieving or curing her was the use of the x-ray, is implicit from all the evidence. The evidence is also to the effect that the lease of life afflicted with sarcoma is, at most, from one and one-half to two years. Dr. Gore, testifying as an expert, said:

"Sarcomas are always fatal, with the possible exception of one occurring on a limb in any early, very early state, the limbs being amputated might possibly stop the growth. I have never known a case of sarcoma that ended any way but fatally. Sarcoma is most rapid-growing of all cancer. . . . They all begin with a very small focus, and when they attain a size when they can be seen and felt, they have then and are probably already not a local thing any more. I mean by that, little tiny pieces of tumor, which are impossible for one to see, get into the blood stream, and are deposited in other parts of the body. A single tiny microscopic particle will cause a new tumor in another location, any part of it becomes attached or fastened to. Cancers do not cause pain in the beginning. Any time that a cancer is causing pain it is no longer a local disease; it is no longer an early case; it is no longer susceptible to operative removal with the expectation of having a cure. By far the greater majority of cancer is fatal;

the persons afflicted die with cancer, irrespective of any kind of treatment they have, and the reason for that is that the patient does not seek medical advice, because he has no pain, and the tumor is allowed to go on until it causes inconvenience, and when it has attained a size and an age whereby it causes inconvenience, it has ceased, in the great majority of cases, to be a local condition; by that we mean confined to the mass that you see. We speak of it as a generalized condition, when it has gone beyond the capsule, spread in other parts of the body, where new masses will grow, and then we have what we call generalized sarcomatosis or carcinomatosis, as the case may be, according to the classification of the tumor. It goes into the blood system, and the same thing is true of the lymph system. It primarily spreads through the lymph system, and is carried up that way, and then enters the blood stream.'

"In witness' statement of the action of and effect of sarcoma upon its victims we must accept as correct, as it is not questioned. When deceased placed her case in defendant's care, it was a desperate one. If the disease were left to run its course, according to the expert testimony, she could live no longer than a year or thirteen months at most. Two physicians of whom she sought aid, concluded that the disease was too far developed for an operative removal, and as a last resort sent her to defendant for x-ray treatment. What was apparent to the experienced professional eye had probably never occurred to deceased, because, paraphrasing Dr. Gore, 'She had suffered no pain, and therefore, sought no medical aid until the tumor caused her inconvenience by reason of its size, and by that time it had ceased to be a local condition.' The defendant under the circumstances, could do no less than try to do something, little though it be, for 'as long as there is life, there is hope.'

"There is no question but that the burn was a serious one; it may have been due, to an overdosage, and thereafter the disease that had been stealthily and painlessly undermining her constitution became painfully articulate in the left abdomen, leg, and face. The expert testified that these pains were caused by the cancerous condition and not by the burn, and considering the nature and malignancy of sarcoma, how can one say that deceased would have suffered no pain, or less pain, or have lived longer than she did, if there had been no burn? At the time she sought defendant's help, the tumor was some four inches long by two inches wide and an inch to an inch and one-half thick, and near it nodules had appeared showing that it was beginning to spread into the blood stream and form other tumors. All the doctors, to wit, Gore, Purcell, Thomas, Huffman,

³ *Butler vs. Rule*, 265 Pac. R., 757.

and Clyne, as also the defendant, testified that the swelling of the leg and abdomen, the paralysis of the left side of the face, and the pain suffered therefrom, were due to the interference of the blood circulation by these cancerous growths or tumors distributed throughout deceased's body.

"In the first trial there was evidence to the effect that the ulcer caused by the x-ray contributed to the death of Mrs. Holloway. There is no evidence, however slight, in the present record, that the ulcer proximately contributed to her death. The law we think is very well settled that the burden was on the plaintiff to show, not only that the defendant was negligent, but that, by reason thereof, Mrs. Holloway's death was caused or hastened. Whether it was or not must of necessity be shown by those acquainted with the effect of such a burn and the nature of the disease being treated; men who have familiarized themselves with the human body and its diseases, and who, by reason of their knowledge and experience, are able to say what results may follow from a given condition.

"The ultimate conclusion of the court and the jury must find a basis in the evidence, and, as it was said by Circuit Judge Taft (now Chief Justice) in *Ewing vs. Goode* (C.C.A.), 78 Fed., 442:

"... When a case concerns the highly specialized art of treating an eye for cataract, or for the mysterious and dread disease of glaucoma, with respect to which a layman can have no knowledge at all, the court and the jury must be dependant on expert evidence."

"Another court has stated:

"It is the settled rule that, where the injuries complained of are of such character as to require skilled and professional men to determine the cause and extent thereof, the question is one of science and must necessarily be determined by the testimony of skilled professional persons." *Oklahoma Hospital vs. Brown*, 87 Okla., 46, 208 Pac., 785.

"If we adopt plaintiff's theory that, because the deceased had suffered no pain nor swelling nor paralysis until after the x-ray treatment, therefore, these evils must be charged against the treatment, we ignore all the evidence. If we presume that all the ill results were the effect of the treatment, we give greater weight to the presumption than the evidence of the expert witnesses. If the presumption and the evidence are placed against each other, still we are left in doubt as to whether the x-ray treatment or the cancerous growth was the proximate cause of death.

"It is said in *Matuschka vs. Murphy*, 173 Wis., 484; 180 N. W., 821:

"Where the proof disclosed that a given re-

sult may have occurred by reason of more than one proximate cause, and that a jury can do no more than guess or conjecture as to which was in fact the efficient cause, the submission of such choice to the jury has been consistently condemned by this court."

"See also *Young vs. Missouri Pac. Ry. Co.*, 113 Mo., App., 636; 88 S. W., 767; *Anton vs. Chicago M. & St. P. Ry. Co.*, 92 Wash., 305; 159 Pac., 115; *Strohm vs. New York L. E. & W. R. Co.*, 96 N. Y., 305; *Miller vs. Director General*, 270 Pac., 330, 113 Atl., 373.

"As stated above, it is left in obscurity and doubt as to whether the pain suffered by the deceased was any greater by reason of the x-ray treatment than it would have been had no such treatment been given; but, since under the decisions of this court the personal representative is suing for the benefit of the estate is entitled to recover only the pecuniary damage suffered by the estate, it is immaterial if the treatment did cause pain which the deceased otherwise would not have suffered. The trial court properly instructed the jury that no recovery could be had for mental anguish and pain. *DeAmado vs. Friedman*, 11 Ariz., 56; 89 Pac., 588; *Phoenix Ry. Co. vs. Landis*, 13 Ariz., 80; 108 Pac., 247, rehearing 13 Ariz., 279; 112 Pac., 844, affirmed 231 U. S., 578; 34 S. Ct., 179; 58 L. Ed., 377; *Arizona Binghamton Copper Co. vs. Dickson*, 22 Ariz., 163; 195 Pac., 538; 44 A. L. R., 881.

"For the reason that the plaintiff has failed to sustain the burden of showing that the x-ray treatment administered by the defendant caused or hastened the death of the deceased, the judgment is reversed, and the cause remanded, with directions that the case be dismissed. *Lockwood and McAllister, J. J., concur.*"

Aside from a very few minor points, these decisions are favorable to radiologists and to the medical profession. The doctrine of *res ipsa loquitur* was not applied and the skill of a radiologist is fixed as the same as that required of a general medical practitioner. Attorneys and radiologists who have suits of this sort to defend, will do well to keep these two decisions in mind, as there is much of value in the decisions themselves as well as in the citations mentioned.

RES IPSA LOQUITUR AGAIN! WHY AND WHEN IT SHOULD APPLY

On several occasions, attorneys have asked me to write my opinion of the appli-

cation of the doctrine of *res ipsa loquitur* as it applies to malpractice, and more particularly as regards its application in suits for malpractice involving the production of a roentgen dermatitis.

An attorney in an eastern State wrote me asking that I discuss the application of this doctrine "in malpractice suits, particularly as regards the so-called x-ray burns." I wrote: "The doctrine or maxim of *res ipsa loquitur* should not apply between or in regard to the relations of a physician and his patient, as argued in the case of *Stemons vs. Turner* (11 Atl. R. 192). It should not apply because when or if an apparent x-ray burn or roentgen dermatitis occurs or exists, without further evidence and proof that negligence or ignorance did exist or that due care had not been applied or that something had been done which modern practice indicates should not have been done. I say this because improper after-treatment of an irradiated area, which has had absolutely correct and proper irradiation, may cause the appearance of conditions which closely simulate roentgen dermatitis, and cannot be distinguished therefrom. In fact, these combined drug and roentgen dermatitis take on all of the undesirable properties of both conditions, and have on numerous occasions been diagnosed as roentgen dermatitis, when, as a matter of fact,—proven by evidence—they were produced by the combined effects of the two. I need only to call your attention to the *Rost vs. Roberts* case in Wisconsin (192 N.W.R. 380) in which I appeared as a witness, and due to my examination of the plaintiff, disclosed that he had used a salicylic acid ointment soon after the application of a perfectly proper amount of roentgen rays, with the result that he developed an ulcer which healed by granulation and resulted in severe scarring. The case hinged entirely upon this point and was decided in favor of the defendant physician, and, upon appeal to the Supreme Court, was upheld.

"Again, in the case of *Offenlock vs. National Pathological Laboratories* in the Cook County, Illinois, Superior Court,

several years ago, all the experts, including those who testified for the plaintiff, were a unit in stating that this condition may and does occur and where and when it does occur, it is indistinguishable from a dermatitis produced by over-exposure to the roentgen rays alone. This was also a part of the defense in the *Ferguson vs. Bellaire* case in Iowa (197 N.W.R., 13).

"Another reason, and in many instances a very important one, why this doctrine should not apply is that the so-called hypersensitive skin or idiosyncrasy to x-rays may be present in the plaintiff in the case, and may apply in the determination of the dose necessary to effect a cure or relief of the condition treated. It is a well-known fact that no one can foretell whether this idiosyncrasy or hypersensitiveness is present or not. In certain of the most chronic and deeper skin diseases, it is necessary to apply sufficient irradiation to produce just short of a roentgen reaction. This degree of effect may consist of epilation or complete falling out of the hair, or even a slight erythema, and if the patient needing such treatment has a very marked hypersensitivity to the x-rays there may be a rather destructive dermatitis produced. *This risk must be taken by the patient*, because in many of the chronic diseases of the skin the x-rays are the best method of relief or cure, and when so used, often highly beneficial and curative effects result.

"Another argument in favor of this, and one that I have never heard brought out in a lawsuit—although it seems a tenable one—is, that in nearly all chronic skin diseases the deformity or defacement produced by the disease is almost invariably worse than the deformity, defacement, or scarring produced by the roentgen dermatitis. Consequently, in order to successfully cure or combat the chronic skin disease, the possibility of the production of a roentgen dermatitis or so-called x-ray burn is the choosing of the lesser of two evils and materially lessening the likelihood of serious permanent deformity, defacement, and scarring.

"I doubt if any physician of experience will admit that when an x-ray dermatitis results from a diagnostic procedure, in the absence of an idiosyncrasy or hypersensitiveness, that *res ipsa loquitur* should not apply, but, on the other hand, that doctrine should never apply when or where the x-rays were applied for therapeutic purposes. That is the universally held opinion of the best radiological therapists in the world to-day.

"Of course, certain exceptions to this opinion, such as the Shockley *vs.* Tucker case (103 N.W.R., 360, 127 La.R., 456), in which the x-rays were applied for the relief or cure of a condition for which they are not indicated and are not a recognized method of treatment, but that was not *per se* the fault of the x-rays. It was just the same as giving large doses of an opium derivative to relieve constipation; simply a misapplication of the therapeutic agent, like applying a very hot application to a burn.

"In the Illinois case where the doctrine of *res ipsa loquitur* was held to apply, the x-rays were used in a diagnostic procedure (Holcomb *vs.* Hannah & McGee, 217 Ill. App., 272). In the recent Johnson *vs.* Marshall case, however, the Appellate Court of this State held that it applied in a therapeutic procedure. This case has not yet been published but appears in the advance sheets only in 241 Ill. App., R. 89. I was at the trial of that case and helped to plan the defense. The case was taken from the jury by the trial judge, but the Appellate Court said that it should go to the jury. I am more than reasonably sure that we will defeat this case on its merits, as *no burn occurred at all*, and the plaintiff is a ne'er-do-well who is merely trying to get some easy money.

"I received a copy of a very recent decision involving this particular doctrine, a few days ago. It will probably interest you. It is from the Appellate Court of Louisiana. I will give you the title of the case and the introductory portion of the decision and then quote that portion of the

text of the decision relative to *res ipsa loquitur*.

"It is 2591 Court of Appeal, Second Circuit, W. Henri Smith *vs.* Hardy and Lett, *et al.*; appealed from the Ninth Judicial District Court of Louisiana, Parish of Rapides. Decision by Webb, Judge.

"The plaintiff's counsel contend that in considering the evidence, the doctrine of *res ipsa loquitur* should be applied, and, if not, that the testimony of the experts as to the probability of a third degree burn being inflicted where the application of the rays were made as claimed by Dr. L. should be considered as either as tending to rebut the testimony of Dr. L. or as supporting the testimony of Mr. W. H. S., they being the only witnesses who attempted to give the factors which were used by the physicians in the application of the rays.

"Many decisions from other jurisdictions have been cited by the parties as to the application of *res ipsa loquitur* in actions for damages against physicians, where the application of the rays has resulted in burns and injuries to their patients, and without reviewing these decisions we may state that they sustain the respective contentions of the parties.

"In those cases where the doctrine is held to be applicable, the court appears to have considered the question more especially with relation to the doctrine in its general application as a rule of evidence, without regard to the rule that the obligation of physicians is that they have the ordinary skill of members of the profession in good standing in like localities, and that they will exercise reasonable care and diligence in their treatment, (R.C.C., Vol. 21, p. 381, No. 27, Physicians and Surgeons; Stern *vs.* Lang, 106 La., 737; Conner *vs.* Brosnan, 165 La., 1); and that in cases in which it appears that the treatment has been in the manner followed by the medical profession generally, the physician is not responsible for results (Conner *vs.* Brosnan, *supra*); while the decisions in which it was held that the doctrine was not applicable have been considered with reference to the rules of law governing the obligations of physicians to their patients.

"In the cases cited, no attempt is made to draw any distinction between the obligations or duty of a physician when using the x-ray machine in the treatment of diseases and when using it for diagnostic purposes, and as counsel do not claim that any distinction should be made, and as we have been unable to find any decision in which such distinction has been made, we assume that it is conceded that if the doctrine is not applicable in cases where the x-

ray machine is used for the purpose of treatment of disease, that it should not be applied where the machine is used as a means of diagnosis.

"With this view, we find that in *Ewing vs. Goode*, 78 Fed.R., 442, where the doctrine was sought to be applied as against a physician, in an action for damages arising from an unexpected result following his treatment in giving drugs, the court said: "If the maxim *res ipsa loquitur* were applicable to a case like this, and a failure to cure were held to be evidence, however slight, of negligence on the part of the physician or surgeon causing the bad result, few would be courageous enough to practise the healing art for they would have to assume financial liability for nearly all of the ills that flesh is heir to."⁴

"The use of the x-ray machines by physicians in the treatment of diseases and as a means of diagnosis, is very general and the use is not regarded by the profession, when in the hands of skillful operators, as any more dangerous than giving drugs by a competent physician.

"In *Nixon vs. Pfahler* (Penn.), 124 Atl., 130, the court having under consideration a case similar to the present, said: "The x-ray machine is indispensable to the healing art, and the mere happening of an accident from its use creates no presumption against the instrument or its operation. It is necessary for those engaged in the medical profession to constantly employ dangerous agencies, like electricity, radium, poisons, etc., and if *prima facie* liability attaches from the use of the one, logically it should from the use of the other, and the practitioner employing such would be practically an insurer of his patients, which the law declares he is not.

"The general obligation of the physician in his treatment of his patient is to follow the usual practice of the profession, and when so doing the law declares that he is not responsible for results, and it seems to us that it would be rather paradoxical for the result of the treatment to be considered as a circumstance in determining whether or not the physician had followed the usual practice, the law being that he is not responsible for results.

"The rules governing the duty and liability of physicians and surgeons in their performance of professional services are applicable to practitioners in the kindred branches of the healing art, such as dentists, oculists, and manipulators of x-ray machines. (R.C.L., Vol. 21, p. 386, No. 31, Physicians and Surgeons.)

"The plaintiff further contends that even if the doctrine is not applicable, that in view of the testimony given by the experts, Doctors

Fortier and Bowie, quoted above, that, in the consideration of the evidence, this testimony must be considered as rebutting the testimony of Dr. Lett, and as going to establish that Dr. Lett, in applying the rays, did not use the factors claimed to have been used by him.

"In *Stemons vs. Turner* (Penn.), 117 Atl., 922, an action against a physician for alleged negligence in the use of an x-ray machine, the trial court charged the jury as follows: "All of the physicians and x-ray specialists agree that by a proper and careful use of a certain and well recognized formula by the profession, which formula has been described and which you will recall, an x-ray burn could not occur. Defendant says he used a formula of even less intensity than that. Obviously, therefore, if the defendant did use the formula which he said he did, then this application of the x-ray did not cause an x-ray burn of the plaintiff's groin, and this defendant was the only person who ever applied x-rays to the plaintiff's groin, then you would be justified in concluding that, while the defendant told you that he used the x-ray according to a harmless formula, he was not telling you the truth, and that on the other hand, the formula that he did actually use was a negligent and improper formula under the circumstances."

"And the Supreme Court said: "This applied the rule *res ipsa loquitur* to the case, and permitted the injury to plaintiff, and nothing else, to speak the negligence; a rule which we have said *does not apply as between doctor and patient*."⁵

"*Res ipsa loquitur* is a rule of evidence which in certain cases makes the injury for which the damages are claimed on the grounds of negligence, a circumstance to be weighed with the other evidence tending to establish negligence, and is applicable only where it has been established that the instrumentality or means through which the injury was inflicted is known to have been in the control of the defendant, and the accident or injury will not ordinarily occur when the instrumentality has been properly handled.

"As previously stated, the evidence of the experts established that where the x-rays are used, having regard to the formula, a burn will not usually result; this evidence of itself could not be considered only as going to establish the basis for the application of the doctrine *res ipsa loquitur*, and although the testimony of the experts, as quoted above, if considered alone, without regard to their evidence as a whole (which we are of the opinion shows that they are not certain that a burn could not be inflicted in some cases, where the formula was used)

⁴ This is the famous Taft decision.

⁵ Italics mine.

could be said to have laid a very firm foundation upon which to rest the doctrine of *res ipsa loquitur*, it could not be considered as anything else than preliminary proof, tending to make out a case for the application of the rule, and if the rule is not applicable in an action against physicians, we do not think the evidence going to make out a case where the rule could ordinarily be applied, can be considered.

"In *Sweeney vs. Erving*, 228 U. S., 232; 57 Law Ed., 815, the court said: "In our opinion *res ipsa loquitur* means that the facts of the occurrence warrant the inference of negligence, not that they compel such an inference; that they furnish circumstantial evidence of negligence where direct evidence of it may be lacking, but it is evidence to be weighed, not necessarily to be accepted as sufficient; that they call for an explanation or rebuttal, not necessarily that they require it; that they make a case to be decided by the jury, not that they forestall the verdict. *Res ipsa loquitur* where it applies, does not convert the defendant's general issue into an affirmative defense. Where all the evidence is in, the question for the jury is whether the preponderance is with the plaintiff."

"In the present case there was testimony offered which tended to show that, where the operator of an x-ray machine used the formula adopted by the profession, a burn would not occur, and if such evidence could be considered in any other respect than establishing a case for the application of the doctrine of *res ipsa loquitur*, it appears to us that in the last analysis the question of negligence would depend upon the weight to be given to the opinions of the experts as to whether a burn could or could not be inflicted where the machine was properly used, which would be to give greater weight to the evidence going to make out a case for the application of the doctrine than could be given in applying the doctrine itself.

"We are, therefore, of the opinion that the doctrine of *res ipsa loquitur* is not applicable, and that any testimony, such as that quoted above, must be considered as going to lay the basis for the application of the doctrine, and that the doctrine not being applicable such evidence cannot be considered as having any weight in determining the question of negligence.

"... We are, therefore, of the opinion that the doctrine *res ipsa loquitur* not being applicable, the plaintiffs have failed to establish negligence.

"For the reasons assigned, it is ordered, adjudged, and decreed that the judgment appealed from be annulled, voided, and reversed and that plaintiff's demands be refunded at his cost."

"I have copies of plaintiff's original petition, defendant's answer, the decision of the District (trial) Court judge and of the Appellate Court in the foregoing extremely interesting and important case. If you want to copy them, I will be glad to lend them to you. I trust this will be what you want."

It is tempting for all of us to draw conclusions from appearances. That is the reason why the doctrine of *res ipsa loquitur* plays such an important rôle in many of our malpractice cases. The writer has read and reread many of the decisions handed down by some of the most learned judges sitting in the Supreme courts of this country, but it is his opinion that the last quoted decision is one of the clearest, fairest, and all-in-all most logical of any of the more recent ones yet published. It is one that should—and doubtlessly will—be used very often in the future.

With the refusal to apply that doctrine, we may begin to rest at least somewhat easier, in that this refusal indicates that a bad result of any kind of treatment must not, cannot and will not be held as indicating negligence or malpractice in every instance, in the State whence this decision emanates. Besides this, many State highest courts will have their attention called to this decision, and we may expect other courts of last resort to follow.

Leaving a sponge in an abdomen, when the nurses report that the count is correct, rightly should not be construed as negligence, but with the application of that doctrine, the matter of the presence of a sponge spoke for itself. In roentgen therapy, in cases in which a marked idiosyncrasy or marked intolerance of radiation exists, the radiologist should not be held liable, because damage may be done when these conditions exist, and no negligence of any kind enters into the production of the damage. It will be well for those who have suits filed, to remember the decision last quoted, because it cites so many others which may help in the defense.

(To be continued)

CASE REPORT

MEDIASTINAL ABSCESS COMPLICATING A RETROPHARYNGEAL ABSCESS

A CASE REPORT

By C. C. JONES, M.D., SAMUEL BROWN, M.D.
and ARCHIE FINE, M.D., *Cincinnati, Ohio*

Retropharyngeal abscess is not a rare disease, but its mediastinal complication is only infrequently observed. Hence the reason for this case report.

A diagnosis of retropharyngeal abscess is, as a rule, not difficult. The clinical manifestations and the physical findings are of such a nature that they make the recognition of the disease relatively easy, but with mediastinal abscess, the findings are somewhat obscure. Since the introduction of the x-ray in the study of the soft structures of the neck and chest, the diagnosis of retropharyngeal and mediastinal abscess has been within the reach of everyone who makes use of it. In spite of the above fact, it is indeed surprising to find that the diagnosis is often missed. Greenwald and Messeloff (1), in a review of 55 cases, point out that the diagnosis was not made in many of the cases for as long as three weeks. Neither do they mention the use of x-ray, although this method of examination has been used with great success for a number of years by radiologists.

NORMAL AND MORBID ANATOMY (CLINICAL AND PHYSICAL FINDINGS)

The retropharyngeal space is only a potential one located between the posterior pharyngeal wall and the prevertebral layer of the cervical fascia. Above, it is limited by the base of the skull, and below it is continuous with the posterior mediastinal space by the prolongation of the deep layer of the cervical fascia. Its contents consist of lax areolar tissue in which are embedded eight to ten lymph nodes, which tend to retrogress after the age of three, so that in adults there may be only one or two nodes remaining. These glands receive afferent lymphatic vessels from the mucous membrane of the sinuses, Eustachian tubes, and nasopharyngeal region and are very frequently involved in upper respiratory infections. As a rule, they undergo resolution without breaking down, but every now and then suppuration may take place, producing an abscess in the retropharyngeal space which may extend downward behind the larynx and trachea into the posterior space. Caries of the cervical vertebrae, and injury and perforation of the pharynx by foreign bodies are other causes of abscess formation. The accumulation of pus

in the retropharyngeal space produces a bulging forward of the posterior wall of the pharynx which encroaches upon the lumen of the pharynx, larynx, and trachea, giving rise to symptoms of obstruction to breathing and swallowing. This mechanical interference is also accompanied by a rise of temperature and other manifestations of an acute pyogenic infection. The abscess may point anywhere in the neck and occasionally may rupture spontaneously.

Roentgenologically, the condition can be diagnosed before pronounced physical signs are present. In the case of the neck a lateral view is essential, the anteroposterior view not being of great help in the study of the soft structures. Under normal conditions a lateral view reveals a layer of soft tissues of varying thickness in front of the bodies of the cervical vertebrae. It is greater in infants and less in adults, but seldom exceeds 1.5 cm. in thickness (2). In abscess formation the pharynx, and at times the larynx and trachea, are displaced forward, while the lumen of the pharynx is encroached upon. Occasionally one may note a foreign body embedded in the soft tissues of the neck, while less frequently a gas bubble may be recognized which is always pathognomonic. The possibility of tumors in this region must be kept in mind. The differential diagnosis must be made after considering the clinical and physical findings.

In the case of a mediastinal abscess an anteroposterior and a lateral view of the chest are necessary. A mediastinal abscess is usually found in the region of the superior and posterior mediastina, the shadow being often circular and extending to both sides of the spine. It may expand more to one side than to the other. In general, it resembles the shadow of a thymic tumor. However, in the lateral position of the chest the shadow, instead of being located anteriorly, as is the case with the latter, is found between the spine and trachea. The trachea is displaced forward through its entire course. In this position it is also possible to note the continuity of the abnormal shadow of the mediastinum with that of the retropharyngeal region.

The case to be reported is that of a white male (R. P.), age 1 year, admitted to the Jewish Hospital, Nov. 13, 1935, on the recommendation of Dr. W. Carmon, with a history of a cold and hacking cough for a week. The clinical diagnosis was that of pneumonia. The child frequently gagged and spit up blood-tinged mucus. Breathing was labored and he refused to eat; when food was given, it was vomited.

Examination disclosed a well developed infant, lying in bed with the head thrown back breathing with considerable difficulty. Respiration

After the x-ray study the infant was re-examined by one of us (C. C. J.); upon holding the patient up by the feet, a marked bulging

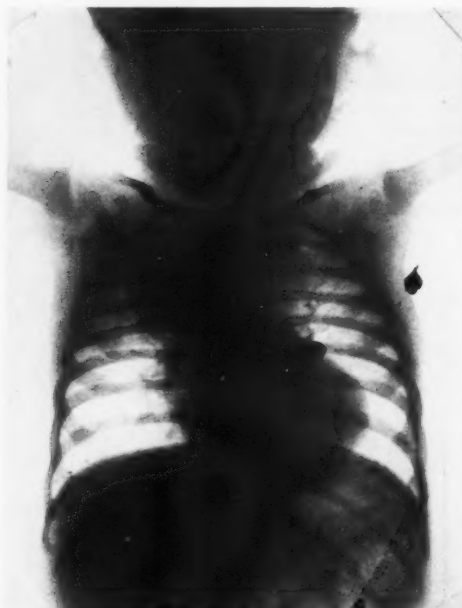


Fig. 1.



Fig. 2.

was of the obstructive type. Examination revealed no bulging or fluctuation on palpating back of the throat with the finger. Chest revealed possible lagging on the right side with slight diminution of breath sounds. Temperature was elevated; respiration and pulse accentuated.

An x-ray examination of the chest revealed, in the anterior view (Fig. 1), a circumscribed homogeneous dense shadow in the region of the superior mediastinum and great blood vessels. The shadow extended more to the right than to the left side. The right upper lobe was somewhat congested. The rest of the lung was normal, as was the heart. The first impression was that of a thymic tumor. In order to determine the exact position of the tumor a lateral view of the neck and chest was made (Fig. 2). No tumor in the region of the anterior mediastinum was revealed, thus excluding that possibility. The homogeneous shadow was found to be located between the spine and pharynx in the neck and between the spine and trachea in the chest, the pharynx, larynx, and trachea being displaced forward through their entire course. A diagnosis of a retropharyngeal and mediastinal abscess was made.

was noted in the posterior pharynx. It was opened, and free pus was obtained. The temperature gradually fell and when the child was re-examined by x-ray on the following day, there was a definite decrease in the size of the mediastinal abscess. It was thought at first that an external operation through the root of the neck was a necessary procedure to evacuate the pus from the posterior mediastinal space, but realizing the difficulties encountered in such an operation, it was decided to limit the drainage to the opening in the oral pharynx and, with the aid of gravity, enable the child to discharge the pus. This conservative procedure justified itself as proven by the favorable outcome of the case.

On Jan. 9, 1936, the child was re-admitted to the hospital because of high fever. An x-ray examination of the chest showed involvement of the right lung apparently due to a pneumonic process. The symptoms gradually subsided and the pulmonary lesion cleared up after several days. Re-examination on March 29, 1936, showed the lung-fields clear and the mediastinal and retropharyngeal regions free from any abnormal changes.

SUMMARY AND CONCLUSION

A year-old boy with a retropharyngeal abscess complicated by a mediastinal abscess was diagnosed by the x-ray. Drainage established through the oral pharynx, assisted by gravity, proved to be sufficient to discharge all the pus, and the baby made a complete recovery.

REFERENCES

- (1) GREENWALD, H. M., and MESSELOFF, C. R.: Retropharyngeal Abscess in Infants and Children. *Am. Jour. Med. Sci.*, 1929, **177**, 767-778.
- (2) HAY, P. D.: *The Neck Roentgenologically Considered*. Paul B. Hoeber, Inc., New York, 1930.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

CALENDAR

MEETINGS FALLING BETWEEN THE DATES OF JUNE 15 AND JULY 31

July 15-17. Denver Radiological Club mid-summer meeting at Shirley-Savoy Hotel, Denver, Colo.

Editor's note.—Will secretaries of societies please co-operate with the Editor by supplying him with information for this page.

CALIFORNIA

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Chairman*, John D. Lawson, M.D., 1306 California State Bldg., Sacramento; *Secretary*, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles. Meets annually with California Medical Association.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION. *President*, D. R. McColl, M.D.; *Vice-president*, John F. Chapman, M.D.; *Secretary*, E. N. Liljedahl, M.D.; *Treasurer*, Henry Snure, M.D. Meets every second Wednesday of month at County Society Building.

PACIFIC ROENTGEN CLUB. *Chairman*, Raymond G. Taylor, M.D., 1212 Shatto St., Los Angeles; *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco.

COLORADO

DENVER RADIOLOGICAL CLUB. *President*, W. Walter Wasson, M.D., 246 Metropolitan Bldg.; *Vice-president*, Ernst A. Schmidt, M.D., Colorado General Hospital; *Secretary*, Nathan B. Newcomer, M.D., 306 Republic Bldg.; *Treasurer*, Leonard G. Crosby, M.D., 366 Metropolitan Bldg. Meets third Tuesday of each month at homes of members. Midsummer Conference, Shirley-Savoy Hotel, July 15-17.

CONNECTICUT

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Chairman*, R. H. Lockhart, M.D., 144 Golden Hill St., Bridgeport; *Secretary-treasurer*, Max Climan, M.D., 242 Trumbull St., Hartford. Meeting, May 19, Hartford.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

FLORIDA STATE RADIOLOGICAL SOCIETY. *President*, Gerald Raap, M.D., 168 S. E. First St., Miami; *Vice-president*, H. O. Brown, M.D., 404 First Nat'l Bank Bldg., Tampa; *Secretary-treasurer*, H. B. McEuen, M.D., 126 W. Adams St., Jacksonville.

ILLINOIS

CHICAGO ROENTGEN SOCIETY. *President*, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president*, Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-treasurer*, Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

ILLINOIS RADIOLOGICAL SOCIETY. *President*, Ivan Brouse, M.D., 316 W. State, Jacksonville; *Vice-president*, Cesar Gianturco, M.D., Carle Hospital Clinic, Urbana; *Secretary-treasurer*, Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

ILLINOIS STATE SOCIETY, SECTION OF RADIOLOGY. *President*, Roswell T. Pettit, M.D., 728 Columbus St., Ottawa; *Secretary*, Ralph G. Willy, M.D., 1138 N. Leavitt St., Chicago. Eighty-seventh annual meeting at Peoria, May 18-20.

INDIANA

INDIANA ROENTGEN SOCIETY. *President*, J. N. Collins, M.D., 23 E. Ohio St., Indianapolis; *President-elect*, Stanley Clark, M.D., 108 N. Main St., South Bend; *Vice-president*, Juan Rodriguez, M.D., 2903 Fairfield Ave., Fort Wayne; *Secretary-treasurer*, Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

MAINE

See New England Roentgen Ray Society.

MARYLAND

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, H. E. Wright, M.D., 101 W. Read St., Baltimore. Meetings each Monday night.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

DETROIT X-RAY AND RADIUM SOCIETY. *President*, C. C. Birkelo, M.D., Herman Keifer Hospital; *Vice-president*, E. W. Hall, M.D., 10 Peterboro St.; *Secretary-treasurer*, E. R. Witwer, M.D., Harper Hospital. Meetings

first Thursday of each month from October to May, inclusive, at Wayne County Medical Society Bldg.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *President*, J. C. Kenning, M.D., 1536 David Whitney Bldg., Detroit; *Vice-president*, A. W. Chase, M.D., 133 Toledo St., Adrin; *Secretary-treasurer*, C. S. Davenport, M.D., 609 Carey St., Lansing.

MINNESOTA

MINNESOTA RADIOLOGICAL SOCIETY. *President*, Walter H. Ude, M.D., 78 S. 9th St., Minneapolis; *Vice-president*, Leo G. Rigler, M.D., University Hospitals, Minneapolis; *Secretary-treasurer*, Harry Weber, M.D., 102 Second Ave., S. W., Rochester. Meetings quarterly.

MISSOURI

THE KANSAS CITY RADIOLOGICAL SOCIETY. *President*, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Mo.; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

THE ST. LOUIS SOCIETY OF RADIOLOGISTS. *President*, Joseph C. Peden, M.D., 634 N. Grand Blvd.; *Secretary*, W. K. Mueller, M.D., 607 N. Grand Blvd. Meetings fourth Wednesday of each month.

NEBRASKA

NEBRASKA STATE RADIOLOGICAL SOCIETY. *President*, Howard B. Hunt, M.D., 4740 Hickory St., Omaha; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 7 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.) *President*, A. E. O'Connell, M.D., 390 Main St., Worcester, Mass.; *Secretary*, E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

NEW JERSEY STATE RADIOLOGICAL SOCIETY. *President*, W. W. Maver, M.D., 532 Bergen Ave., Jersey City; *Vice-president*, J. D. Tidaback, M.D., 382 Springfield, Summit; *Secretary*, P. S. Avery, M.D., Middlesex General Hospital, New Brunswick. Meetings at Atlantic City at time of State Medical So-

ciety, and Midwinter in Newark as called by President.

NORTH CAROLINA

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *President*, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists). *President*, Harold G. Reineke, M.D., Cincinnati General Hospital, Cincinnati; *Secretary-treasurer*, George Benzing, M.D., St. Elizabeth's Hospital, Covington, Ky. Meetings third Tuesday of each month.

PENNSYLVANIA

PENNSYLVANIA RADIOLOGICAL SOCIETY. *President*, W. E. Reiley, M.D., Clearfield; *First Vice-President*, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *Second Vice-president*, Louis A. Milkman, M.D., Medical Arts Bldg., Scranton; *Secretary-treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Sydney J. Hawley, M.D., Geisinger Memorial Hospital, Danville. Annual meeting, May 21-22, Erie.

PHILADELPHIA ROENTGEN RAY SOCIETY. *President*, Thomas P. Laughery, M.D., Germantown Hospital; *Vice-president*, Elwood E. Downs, M.D., Jeans Hospital, Fox Chase; *Secretary*, Barton H. Young, M.D., Temple University Hospital; *Treasurer*, R. Manges Smith, M.D., Jefferson Hospital. Meeting first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 8:15 P.M.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

SOUTH CAROLINA X-RAY SOCIETY. *President*, Robert B. Taft, M.D., 105 Rutledge Ave., Charleston; *Secretary-treasurer*, Hillyer Rudisill, M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

MEMPHIS ROENTGEN CLUB. Chairmanship

rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

TENNESSEE STATE RADIOLOGICAL SOCIETY. *President*, H. S. Shoulders, M.D., 246 Doctors Bldg., Nashville; *Vice-president* S. S. Marchbanks, M.D., 508 Medical Arts Bldg., Chattanooga; *Secretary-treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

RADIOLOGICAL SOCIETY OF VIRGINIA. *President*, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, University of Virginia Hospital, Charlottesville.

WASHINGTON

WASHINGTON STATE RADIOLOGICAL SOCIETY. *President*, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

CALIFORNIA

THE SECTION ON RADIOLOGY OF THE CALIFORNIA MEDICAL ASSOCIATION met May 2-5, at Hotel Del Monte, Monterey County, and elected for the 1937-38 *Chairman*, this past year's *Secretary*, John D. Lawson, M.D., 1306 California State Life Bldg., Sacramento, and *Secretary*, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles.

INDIANA

THE INDIANA ROENTGEN SOCIETY held its annual meeting at Indianapolis on May 9, with J. C. Bell, M.D., of Louisville, Ky., as guest for the day. After dinner he addressed the Society on "The Less Common Diseases of the Colon, including Amebiasis." Officers chosen for the coming year are: *President*, J. N. Collins, M.D., Indianapolis; *President-elect*, Stanley Clark, M.D., South Bend; *Vice-president*, Juan Rodriguez, M.D., Fort Wayne, and *Secretary-treasurer*, Clifford C. Taylor, M.D., Indianapolis.

MINNESOTA

The annual meeting of the MINNESOTA RADIOLOGICAL SOCIETY was held in St. Paul,

Minnesota, in connection with the meeting of the Minnesota State Medical Society. The annual Carman Lecture was delivered to the general assembly of the Minnesota State Medical Association by Edward H. Skinner, M.D., of Kansas City, on "Reflections on the Roentgenology of Fractures."

Dr. Skinner also addressed the Minnesota Radiological Society on the subject "Comments upon Early Books upon Electricity and the Roentgen Ray."

Robert S. Stone, M.D., of San Francisco, delivered the annual Christian Lecture on Cancer before the State Medical Society. His subject was "Irradiation Therapy of Tumors, with a Consideration of the Possibilities of Super-voltage X-rays." He also addressed the Minnesota Radiological Society on "The Professional and Economic Status of the Radiologist."

Officers for the coming year were elected as follows: *President*, Walter H. Ude, M.D., Minneapolis; *Vice-president*, Leo G. Rigler, M.D., Minneapolis; *Secretary-treasurer*, Harry Weber, M.D., Rochester.

MISSOURI

THE ST. LOUIS SOCIETY OF RADIOLOGISTS has recently been re-organized, with the following officers elected for the forthcoming year: *President*, Joseph C. Peden, M.D., and *Secretary*, W. K. Mueller, M.D. Meetings are now held the fourth Wednesday of each month.

NORTH CAROLINA

THE NORTH CAROLINA RADIOLOGICAL SOCIETY met May 3-5, in Winston-Salem, electing the following officers: *President*, Robert P. Noble, M.D., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., Rocky Mount, and *Secretary-treasurer*, M. I. Fleming, M.D., Rocky Mount.

Part of the meeting was taken up with a rather lengthy discussion and an unanimous vote of the Society that the members discourage the employment by hospitals of a radiologist who is not especially qualified, the hospital paying a nominal salary and charging the regular x-ray fee for his services. This means that some of the hospitals in the State are using an interne or a young doctor who is not especially qualified in x-ray as their x-ray man and charging the patients a fee for his service not in keeping with the salary he gets. The Society wishes to go on record that such a procedure is not in keeping with its idea of a real radiologist.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor*

HOWARD P. DOUB, M.D., *Associate Editor*

GROUP HOSPITALIZATION

Organized radiology has definitely gone on record opposing any group hospitalization plan which includes radiology or any other medical service in its contract. We have known for a long time that such a practice was not in accordance with the principle of the American Medical Association. We find in the *Journal of the American Medical Association*¹ of April 4, 1936, a very definite statement by the Bureau of Medical Economics of the American Medical Association which states:

"Group hospitalization by its very name connotes that the relationship is one of direct arrangements between hospitals and groups and that hospital care alone is the service bargained for. Group hospitalization, then, is a plan whereby a hospital or an association of hospitals contracts with classified groups of people to furnish hospital care when needed in return for the periodic payment or prepayment of a stipulated sum by each member of the group. A *bona fide* group hospitalization plan, as defined, should exclude all professional or medical services of physicians or surgeons, pathologists, roentgenologists, anesthetists, and special nurses. The control of the service provisions and membership funds should be in the hands of those who can render the service; namely, the hospitals or an association properly representative of the hospitals and the medical profession."

In spite of this we find local medical organizations continuing their endorsement of such group insurance plans. This indifferent attitude on the part of certain medical organizations must change, not to protect radiology but to save medicine. It may be that they will alter their position in this regard after reading the report of the Bureau of Medical Economics, in the May 1, 1937, issue of *Journal of the American Medical Association*, which because

of its importance to radiology, we herewith present in part to our readers.²

"In certain States the compensation laws permitted the formation of associations to provide medical and hospital care for employees entitled to compensation and authorized payroll deductions from employees. Such associations almost surreptitiously added medical care and hospitalization for non-compensable injuries and illnesses and brought a loosely constructed organization into the medical and hospital fields. In other States the laws permitted the expansion of medical services provided by employers to care for non-compensable as well as compensable conditions, but most State laws stipulated that employers alone should pay for compensation claims. To provide the medical and hospital services, employers expanded their industrial health services, used subsidized or company-owned hospitals, and formed contracts with physicians, hospitals, and medical and hospital benefit associations—generally with the expectation of lowering accident costs or of securing more favorable personnel relations with employees.

"Much dispute and ill feeling has arisen because of the failure to differentiate between industrial health services and medical service systems. Industrial health services are maintained entirely at the expense of the employer to fulfill his responsibility, sometimes as a 'self-insurer,' for industrial injuries. The objectives are to safeguard employees against accidents and to provide prompt medical supervision (first aid) for the prevention of serious complications from minor accidents. Under medical service systems the employees and their dependents, in consideration for a fixed periodic deduction from wages, are furnished medical and hospital care through medical personnel employed by or under contract to the employer.

¹ "Bureau of Medical Economics." *Jour. Am. Med. Assn.*, April 4, 1936, 1106, 1182, 1183.

² The second in a series of articles on group hospitalization.

Industrial health services are extended to provide care for acute and chronic illnesses and more or less complete medical care for the employee's family.

"The creation of medical service systems to furnish complete medical, surgical, and hospital care for employees does not seem to be the proper function of industry. Financial provisions may be made by industry to alleviate the lack of individual employee income, but the medical and hospital service should be given by physicians and hospitals independent of industry. Under such an arrangement the employer could help employees to purchase medical and hospital services without undesirable entanglements in the medical field. It is believed that personnel managers would welcome an arrangement for medical services which does not place their companies between the patient and his physician or hospital.

"There is need for much further consideration of the discrimination against independent physicians and hospitals and of the inequities placed on the employee by industrial medical systems.³ At present it is sufficient to note that, in certain industries, employees and their dependents receive medical and hospital care (part of which is definitely the legal liability of the employer), under a group payment plan, from physicians employed in company-owned hospitals or from physicians and hospitals under contract with the employer.

"It was not long before medical and hospital benefit organizations were formed in imitation of the associations contracting for the care of patients entitled to compensation. Under the various plans, funds were accumulated from individual subscribers as well as from groups of employees through the sale of contracts. Complete medical and hospital services were offered through hospitals and clinics owned by the organizers or through physicians and hospitals under contract with the corporation. In the States where the laws or the courts denied corporations the right to practise medicine,

these organizations made little progress; but in those States in which the laws did not restrict such corporations they were promoted at a pace that would astound even a firm believer in the gullibility of the American people. In one State alone 143 such organizations were formed, 37 of which used two or more names. Many of these corporations (some of which appeared to be only on paper) defrauded thousands of people of money which they thought they were paying for future medical services until grand jury action was secured and the laws were altered to prohibit such swindling corporations. In other localities similar organizations were more honestly promoted, but, while avoiding criminal fraudulence, they still retained the contract features restricting free choice and preventing freedom of reasonable competition on a service basis.⁴

"Many mutual benefit associations or sick benefit funds organized by employees, trade unions and fraternal societies developed alongside the industrial health services and medical systems. The primary function of these plans was to collect payments from the group into a fund to provide benefits in cash for members requiring assistance. These organizations, after the losses from industrial injuries were transferred to the employer, confined themselves to ordinary sicknesses or injuries not the result of employment. In addition to cash benefits for loss of time, several of the plans included payments for medical and hospital care. Only a few plans provided such service 'in kind' through salaried physicians and association-owned hospitals or through physicians and hospitals under contract with the association. Most of the plans also included medical and hospital service for dependents of members. By far the greater number of these plans were little more than charity arrangements in that they were designed primarily to aid the member who became impoverished because of illness or accident.⁵

⁴ These organizations are discussed in *New Forms of Medical Practice*, Bureau of Medical Economics, American Medical Association, Chicago, American Medical Association, 1933, pp. 61-64. Leland, R. G.: *Contract Practice*. Jour. Am. Med. Assn., March 5, 1932, **98**, 808. *Some Phases of Contract Practice*. Am. Med. Assn. Bull., October, 1932, **27**, 142. *New Plans of Medical Service*. Chicago, Julius Rosenwald Fund, 1936.

⁵ Medical benefits under mutual and sick benefit associations are discussed by Brundage, D. K.: *A Survey of Work of Employees' Mutual Benefit Associations*. Pub. Health Rep., Sept. 4, 1931, **46**, 2102. Williams, chapter XII.

³ For a full discussion of the evolution of industrial medical services see (a) *Medical Relations under Workmen's Compensation—Revised*. Bureau of Medical Economics, American Medical Association, Chicago, American Medical Association, 1935. (b) Williams, Pierce: *The Purchase of Medical Care through Fixed Periodic Payment*. New York, National Bureau of Economic Research, Inc., 1932. (c) Dodd, W. F.: *Administration of Workmen's Compensation*. New York, Commonwealth Fund, 1936. (d) *Medical Supervision and Service in Industry*. New York, National Industrial Conference Board, Inc., 1931.

"Group medical practice plans or so-called private group clinics, whereby physicians cooperate in their practice, share office space, own certain kinds of equipment and employ lay assistants in common, are frequently cited as examples of desirable group payment arrangements. A comprehensive study of such groups,⁶ however, revealed that less than 9 per cent (20 out of 224) had ever tried any arrangement for service in return for regular periodic payments. Furthermore, despite the claimed economies of group medical practice plans, it was found that the cost of practising medicine in private practice varies from 27 to 34 per cent of gross income, with an average tendency of 33 per cent, whereas in group medical practice the cost varies from 40 to 42 per cent, or from 7 to 9 per cent more than in private practice.

"A few communities organized 'health associations' to provide hospitalization and medical or nursing services to subscribing members. While such organizations have usually been subsidized by foundations, welfare federations, or other community institutions, the essential distinction is that the administration is separate from the physicians and hospitals providing the service. Such arrangements did not lend themselves to the average American community because of their dependence on community or special benevolent funds and the restricted character of their activities.⁷

"In universities and colleges, student health services were organized to meet the requirements of supervising and protecting the health of students on the campus through entrance examinations, consultations and infirmary care, instruction in personal and public hygiene, and the control of communicable diseases. Such organizations might be compared to industrial health services with particular emphasis on health education. The tendency to extend student health services into comprehensive medical care plans is similar to that which exists

under industrial health services. Again, the claimed economies of group arrangements do not seem to materialize because, in spite of uncertain accounting methods, the reported cost per student is not appreciably less than the cost for similar services in the private purchase of medical and hospital care.⁸

"It should be noted that all of the several plans which have been outlined have provisions for periodic payments by members to establish a fund for hospital, and sometimes medical, bills. Nevertheless, such plans are not group hospitalization plans. The characteristics which set group hospitalization plans apart from these plans will be outlined later.

"*The Beginnings of Hospital Plans.*—With the background of industrially dominated group payment for medical and hospital care, it is not surprising that hospitals should form plans to accumulate funds through individual contributions and then through group payroll deductions.

"In the latter part of the nineteenth century hospitals began selling 'season tickets,' entitling the purchaser to hospital benefits in case of accident or illness, as a means of securing advance working capital. The practice started, presumably in the small hospitals of Michigan for workers in the lumber woods, although some hospitals in cities, such as the Broadstreet Hospital in New York City, were supported by annual pledges of employees and employers.

"The first organized payment plan for hospital services offered to the general public by a hospital was that of the Grinnell Community Hospital, Grinnell, Iowa, which began operation in 1918. Subscription rates were \$8 a year for single persons and \$12 for husband and wife, with \$5 for the first child and \$2.50 for each additional child. Later, students of Grinnell College were admitted for \$5 per college year. The benefits included three weeks of hospital care consisting of board and room and floor nursing service, but did not include use of operating room, delivery room, x-ray, or laboratory fees, or the costs of dressings or special nursing. This plan is still in operation and has remained practically unchanged in rates, contract provisions, or size of membership.

⁸ University and College Student Health Services, Bureau of Medical Economics, American Medical Association, Chicago, American Medical Association, 1936. Compared with Griswold and Spicer: University Student Health Services, Committee on the Cost of Medical Care, Publication 19, Chicago, University of Chicago Press, 1932.

⁶ Group Practice, Bureau of Medical Economics, American Medical Association, Chicago, American Medical Association, 1933, p. 29. Compare with Rorem, C. R.: Private Group Clinics, Committee on the Costs of Medical Care, Publication 8, Chicago, University of Chicago Press, 1931.

⁷ Williams, chapter X. Peebles and McDermott: Nursing Service and Insurance for Medical Care in Brattleboro, Vermont. Committee on the Costs of Medical Care, Publication 17, Chicago, University of Chicago Press, 1932. Falk, Griswold, and Spicer: A Community Medical Service Organized under Industrial Auspices in Roanoke Rapids, North Carolina. Committee on the Costs of Medical Care, Publication 20, Chicago, University of Chicago Press, 1932.

"Many other plans for facilitating the purchase of hospital care were organized, such as the Hospital Service Association of Rockford, Ill., in 1912, the Thompson Benefit Association for Hospital Service, Brattleboro, Vt., in 1927, and the New Bedford Health Association, New Bedford, Mass., in 1929. These undertakings were community ventures to carry the risk of illness on a group basis but with the provision of hospital and medical service left largely to independent local agencies.

"Alongside the organized undertakings, individual hospitals formed a multitude of other plans designed to bolster the diminishing income from patients, gifts, and endowments and at the same time to make hospitalization costs less for patients of moderate means."

COMMUNICATIONS

INTERNATIONAL CONGRESS OF SHORT WAVE SPECIALISTS

Vienna, Austria, July 12-17, 1937

The scientific workers in one of the most rapidly advancing fields of physics, chemistry, biology, and medicine will convene in congress in Vienna under the patronage of Dr. D'Arsonval, Dr. Zenneck, Senator Marconi, and of official Austria as represented by a committee including the Federal President, the Austrian Chancellor, the Rector of the celebrated University of Vienna, the Rector of the Vienna Technical College, and the Mayor of the City of Vienna. The Congress sessions will comprise lectures by world-famous scientists, followed by brief papers by members, and by general discussions. The papers read by members must not take more than fifteen minutes' reading time. Those wishing to read papers are requested to file a special application. The languages admitted are English, German, French, and Italian. The major papers read, as well as those presented by members, will be printed in full and copies distributed to those attending the Congress provided applications are received in time. In conjunction with the Congress an exhibit showing the latest advances in the short wave field, both in the abstract field and the field of applied practice, will remain open throughout the Congress.

The subjects to be dealt with include: physics, biology, chemistry, and medicine. In

the field of physics the subjects to be covered are: the properties of short waves and ultra-short waves; generation, conduction, radiation, and propagation; reflection, refraction, absorption; measurement of SW and USW; exploration of Heaviside-Appleton layers of the atmosphere; chemistry and physical chemistry will be thoroughly explored in their relation to short wave work and the practical aspects of short wave application in the physical field will be treated extensively.

In biology the action of short waves of various types on plants, animals, organisms, enzymes, and ferments; heat effect and size particles; percutaneous SW diathermy; destruction of noxious insects. Experiments will be included.

In the medical field, the connection of which with short wave therapy has aroused world wide interest, the following topics will receive attention: indications and counter-indications for the therapeutical application of SW and USW; USW therapy—its application in cases of acute inflammations of bacterial genesis in internal medicine, surgery, gynecology, dermatology, ophthalmology, otiatry, and neurology; SW therapy in connection with acute infectious diseases, especially with polymyELITIS acuta; sensibilization by SW of malignant neoplasms refractory to x-rays; SW diathermy—its application in cases of chronic rheumatic diseases of joints and muscles; the technical side of apparatus.

All lectures and discussions will take place in the morning, leaving the afternoons free for demonstrations, experimental work, or sight-seeing tours. Membership fee of the Congress is thirty Austrian schillings which fee includes the cost of all printed reports. The fee is payable in the local currency to the official Austrian representatives abroad. A crowded calendar of social events including official receptions and merry excursions has been planned to supplement the serious work of the members of the Congress.

Programs and application blanks will be furnished upon request to the Congress of Short Wave Specialists, 630 Fifth Ave., New York City.

Announcements concerning the Fifth International Congress of Radiology and the joint meetings of the radiological societies (Chicago, Sept. 13-17, 1937) will appear in future issues.

FREE SUMMER COURSE ON BOARD TRAINING SHIP FOR BOYS AND YOUNG MEN¹

In order to acquaint the youth of America with the opportunities of a career as officers in the United States Merchant Marine, the American Nautical Academy, National Training School for Merchant Marine Officers, Washington, D. C., has announced that boys and young men between the ages of 10 and 26 years will be allowed to secure practical ship experience on board a training ship of the Academy within the period from June 1 to October 1.

The young men may remain on board ship for the entire period or for any shorter time they may wish, but not for less than three weeks.

There is no tuition charge for any of the courses offered by the Academy, and no obligation for future merchant marine, military, or naval service of any kind is incurred by the young men.

There is no charge for instruction nor for living quarters on board ship. The only required expense is for meals which are 49 cents. Three meals are served daily.

The schoolship to which the young men will be assigned is the Training Ship *Marsala*, a five-masted barkentine-rigged vessel of 2,500 tons, 300 feet long, and 46 feet wide. The vessel was built in 1919-20 and is one of the largest sailing vessels in the world.

While on board ship cadets will receive free medical treatment when necessary. On Sundays the young men will be allowed to attend divine services at the churches of their respective denominations ashore.

This is the eighth annual summer course offered by the Academy, and will be under the personal supervision of the Captain Commandant of the Academy who will be in command of the vessel.

While on board ship the boys will follow the regular daily ship routine, and will be given practical instruction in nautical subjects including seamanship (ship's work), signaling, rowing, handling, and the use of motor and life boats, life-saving, and naval drills. They will also receive instruction in the use of life buoys, first aid, the duties of lookouts, the compass, log, lead, and ground tackle, as well as the duties of the watch in port and at sea.

Students will join the training ship in the

¹ This summer course seems to offer physicians attractive summer occupation for their young sons.

vicinity of New York Harbor for the summer training period.

Those completing the summer course with a passing grade will be eligible to apply for a scholarship in the Regular Course.

The Regular Course covers a period of three years. The first two of these years the cadet spends cruising, and studying on the training ship. For the third year the cadet is assigned to a steamship of one of the merchant marine lines. Following the completion of these three years of sea service the cadet is eligible to take the officer's examination of the United States Bureau of Navigation and Inspection, Department of Commerce, for a certificate as a Third Officer in the Deck Division of steamships in the Merchant Service of the United States.

Due to the fact that the number of accommodations available is limited, those wishing to take advantage of this opportunity should write at once to the American Nautical Academy, National Training School for Merchant Marine Officers, Washington, D. C.

BOOK REVIEW

THE LUNG. By WILLIAM SNOW MILLER, M.D., Emeritus Professor of Anatomy, University of Wisconsin. A volume of 209 pages with 152 illustrations. Published by Charles C. Thomas, Springfield, Illinois, 1937. Price, \$7.50.

This short monograph presents a most important contribution to the literature dealing with the anatomy of the lung. There is probably no one better qualified to deal with the subject, and able to present in the same excellent and readable style, than the author. It should be carefully studied by all physicians, and especially those interested in diseases involving the lung.

The book is divided into twelve chapters, each dealing with some important structural element of the lung. The chapters are abundantly illustrated, the illustrations adding materially to a better understanding of the anatomical detail. The diagram representing the structural scheme of a primary lobule is especially worthy of notice. While each chapter pays attention to anatomical detail, the material is presented in such a fashion that it blends readily into a compact whole.

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E. T. LEDDY, M.D., of Rochester, Minn.	WILLIAM R. STECHER, M.D., of Easton, Pa.
ERNST A. POHLE, M.D., Ph.D., of Madison, Wis.	CHARLES G. SUTHERLAND, M.B., of Rochester, Minn.

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SKELETON

A Radiologic Study of Some Anomalies and Congenital Malformations of the Skeleton and the Joints. Mariano Cipriani. *Archivio di Radiologia*, March-April, 1936, 71-90.

The author discusses the roentgenologic aspects of some anomalies and malformations of the bones and joints among which are a case of "foramen supratrochleare humeri," "os intermedium antibrachii," "ectromelia," "syndactylism," "hyperdactylism," and "os trigonum tali." Of special interest was the case of a girl nine years of age who had hyperdactylism of all the digits and syndactylism of the hands, bilateral coxa valga, hypoplasia and dysplasia of the tibias, and hyperplasia and dysplasia of the fibulas. The author draws up a classification of such lesions and, in conclusion, emphasizes the importance that skeletal anomalies and malformations may have in medico-legal questions.

E. T. LEDDY, M.D.

TUMORS (THERAPY)

Treatment of Tumors of the Reticulo-endothelial System. Ira I. Kaplan. *Jour. Med. Soc. New Jersey*, December, 1936, 33, 696-701.

For the purpose of radiation therapy certain tumors may be classified in distinct categories entirely upon the basis of the nature of their response to this radiant energy. Tumors of the reticulo-endothelial system, which have not as yet been pathologically or embryologically linked to a single tissue of embryonal origin, may be classified purely through clinical radiation therapy. The point of origin cannot dictate the reason for the radiosensitivity but leads to a grouping of tumors accordingly. Leukemia, lymphosarcoma, Hodgkin's disease, lympho-epithelioma, and the endothelioma of bone are placed in one group as representative of very sensitive tumors. The less rapidly regressing xanthochromatoses, such as Gaucher's, Schüller-Christian's, and Niemann-Pick's disease, are placed in a second group.

W. A. SODEMAN, M.D.

Giant-cell Bone Tumor: Further Observations on Treatment. Carleton B. Peirce and Isadore Lampe. *Jour. Am. Med. Assn.*, Dec. 5, 1936, 107, 1867-1871.

A series of 40 cases are reviewed, with particular reference to the results obtained in treatment. With thorough curettage, surgery alone is effective in the control of this tumorous lesion of bone. Adequate curettage, with or without cauterization, was as effective as curettage with radiation. In cases in which the location of the tumor, the age or physical condition of the patient, or the loss of time incident on surgical attack were factors, radiation offered symptomatic relief and anatomic improvement. Radiation alone

offered as much for the control or cure of giant-cell tumor as either of the other methods. Large or massive doses are theoretically of less value than smaller and more frequent amounts of radiation and tend to be more irritating to the normal connective tissue elements.

CHARLES G. SUTHERLAND, M.B. (Tor.).

Electrolysis or Diathermic Coagulation in the Treatment of Vascular Tumors of the Face. Roberto Pochy-Riano. *Archivio di Radiologia*, March-April, 1936, 121-133.

The author reports the checking by surgical diathermy of a case of extrinsic cavernous hemangioma of the upper lid of an 18-months-old baby.

E. T. LEDDY, M.D.

The Influence of Sugar and Insulin Injection upon the effect of X-rays on Malignant Tumors. K. Inouye. *Strahlentherapie*, 1937, 58, 125.

The author studied the relation between sugar injection and metabolism of sarcoma in rabbits in connection with roentgen irradiation of the tumor. The sarcoma was transplanted on the back of rabbits and received from 1,200 to 6,000 r. Tumor growth, body weight, and duration of life of the animals were used as criteria. Intravenous injection of 20 c.c. of a 20 per cent glucose solution increased the metabolism of the sarcoma. The inhibiting effect of roentgen rays on the metabolism of the tumor was increased if preceded by sugar injection. Insulin injection (1 c.c. per kilogram of body weight) after the exposure to roentgen rays has the same effect. Sugar injection before roentgen irradiation seems to inhibit the growth of the tumor and increase the duration of the life of the animals. If sugar is injected and not followed by irradiation, the general condition of the animals is improved, but the tumor grows more rapidly and is fatal in a shorter time. While roentgen irradiation alone is followed by decrease of the tumor size, it causes enough systemic injury to shorten the duration of the life of the rabbits. The growth of implanted tumors may be inhibited by early roentgen irradiation.

ERNST A. POHLE, M.D., Ph.D.

On the Spacing of Radiation According to Variation in Radiosensitivity. J. C. Mottram. *British Jour. Radiol.*, December, 1936, 9, 824-832.

The author exposed bean roots to radium radiation at varying intervals in relation to the mitotic activity. His results showed that 6-hour spacings were less effective in causing death of the bean root, or in temporarily stopping growth, than the 24-hour spacings. It was also demonstrated that unspaced exposures of the same total time are less damaging than the 24-hour spacings, though slightly less than the 6-hour spacings. In the experiments employing 24-hour spacings the cells were irradiated at both exposures when mitosis was abundant. In the 6-hour spacings the second exposure was administered when mitosis was in abeyance.

It is believed that if the radiosensitivity of tumors could be measured during life, radiation could be more efficiently applied to patients. It would then be possible to expose the tumor during periods of high sensitivity and avoid those periods of great resistance. While this is possible in the case of experiments, the only means to estimate radiosensitivity of tumors is by frequent measurements of the tumors, and assuming that during regression the tumor will be resistant and during growth, sensitive.

J. N. ANÉ, M.D.

ULTRA-VIOLET LIGHT

Experimental Studies on the Influence of Ultra-violet Rays on Cell Protoplasm. L. N. Kljatschkin. *Strahlentherapie*, 1937, **58**, 330.

The author exposed mice to the quartz mercury vapor lamp without filter and also through the so-called Wood filter. The kidneys, liver, and spleen were studied histologically then by means of a modified Altmann stain. Definite structural changes could be demonstrated which made their appearance at the time. No changes whatsoever in the nucleus could be detected by the customary histologic method. The author observed those changes as early as one hour after exposure.

ERNST A. POHLE, M.D., Ph.D.

THE UTERUS

The Question of Colposcopy. E. Anderes. *Schweiz. med. Wchnschr.*, Nov. 14, 1936, **46**, 1107-1111.

The entire future of therapeutic results in carcinoma of the cervix depends upon means of establishing an early diagnosis. Since the devisement of the colposcope by Hinselmann, rapid strides have been made, namely, in the detection of incipient carcinoma of the portio such as is readily overlooked in ordinary direct examination. If one does not utilize a colposcope, the author recommends the routine employment of the Schiller iodine test, and advises that in all negative cases, an auxiliary colposcopic examination by an experienced examiner should be conducted.

WILLIAM R. STECHER, M.D.

Blood Changes in Patients with Carcinoma of the Uterus before and after Radiation Therapy and Their Prognostic Significance. H. Goecke. *Strahlentherapie*, 1936, **57**, 675.

The blood counts of 110 patients with carcinoma of the uterus (100 carcinoma of cervix and 10 fundus) were studied before radiation and four months later. This corresponded to a period of two months after the last treatment. It appeared that the changes occurring in the blood count after radiation therapy can be used as a guide in prognosis. If hemoglobin and erythrocytes increase after the treatment, while the leukocytes decrease and the shift to the left returns toward

normal, at the same time the lymphocytes remaining high, the prognosis is usually favorable. A further drop in hemoglobin and erythrocytes after radiation therapy is unfavorable. The same conclusions may be drawn from the appearance of a leukocytosis, with marked shift to the left and drop of lymphocytes and eosinophils.

ERNST A. POHLE, M.D., Ph.D.

Remarks Regarding the Results in Treatment of Carcinoma of the Cervix at the Women's Clinic, University of Breslau. H. R. Schinz. *Strahlentherapie*, 1936, **57**, 655.

In this communication the author criticizes a paper published by Reiprich in "*Strahlentherapie*," 1934, **51**, 601, and points out certain misleading interpretations of Reiprich's statistics. He urges further study of the material and a supplementary publication.

ERNST A. POHLE, M.D., Ph.D.

THE WRIST

Treatment of Luxation of the Lunate. Peter Steiner. *Schweiz. med. Wchnschr.*, May 23, 1936, **66**, 504-507.

The author presents an excellent review of luxation of the lunate, intercarpal luxation, and other carpal bone injuries. The importance of this study cannot be over-emphasized when one considers that more than half of all carpal bone injuries, and particularly luxation of the lunate, are diagnosed only after three weeks' duration; which factor makes all manual non-operative reduction impossible. The only method of diagnosing this condition, and even then only in skilled hands, is by roentgenology. An early diagnosis is the key-note to therapy; for before three weeks elapse, excellent results in reduction are obtained by employing the Böhler technic, which essentially consists of continuous traction with the hand in supination. When luxation is older than three weeks, operative reduction is necessary, which is as successful as the non-operative method. However, in old luxations, operative removal is necessary if there is pain and interference with articular motion. In the latter regard, conservative treatment may be advisable if the terminal results appear certain of non-success. Associated avulsion of the styloid process of the ulna is common, as is transverse fracture of the navicular. The luxation can best be noted in the lateral projection, and a control roentgenogram of the opposite wrist is always indicated. Excellent illustrations showing the lesions are given, and radiologic hints for diagnosis are well worth while reading in the original. The mechanism of luxation is clearly shown, and the dictum that every so-called sprained wrist, due to the patient having fallen on the dorsally flexed hand, is a luxation of the lunate until disproven, is very valuable.

WILLIAM R. STECHER, M.D.

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY
AND ALLIED SCIENCES

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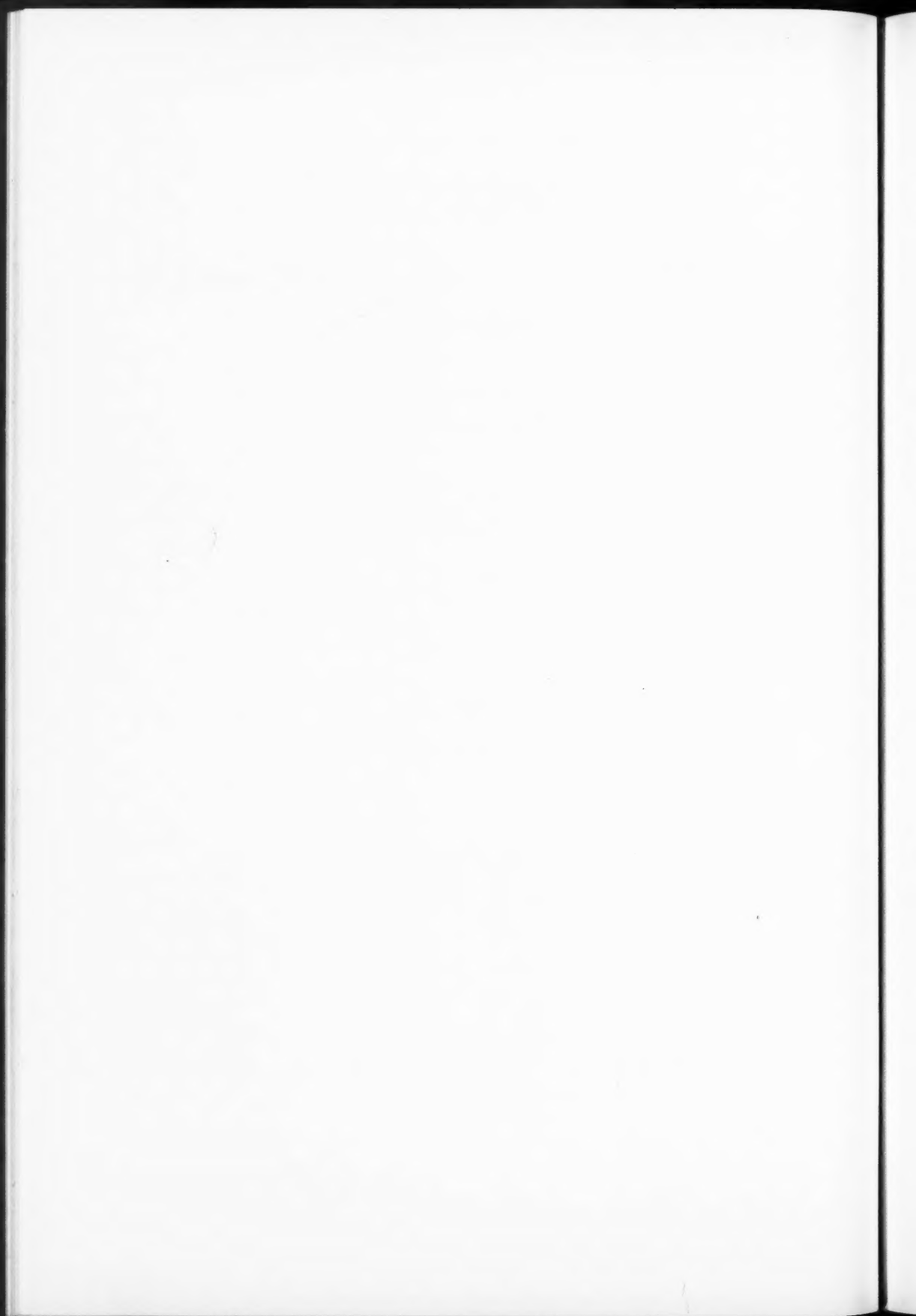
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